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The Rolls-Royce Crankshaft

Main Bearings Rough Turned, Crankpins Ground From the Rough—Finishing Completed Unit of Crankshaft, Flywheel and Clutch Ring

By FRED H. COLVIN
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THAT the crankshaft is one of the most important members of a successful motor is indicated by the care taken in the Rolls-Royce plant to have it as perfect as can be secured. To this end, there are sixty-five operations, beginning with the heat-treatment, which must secure a Brinnell test of between 286 and

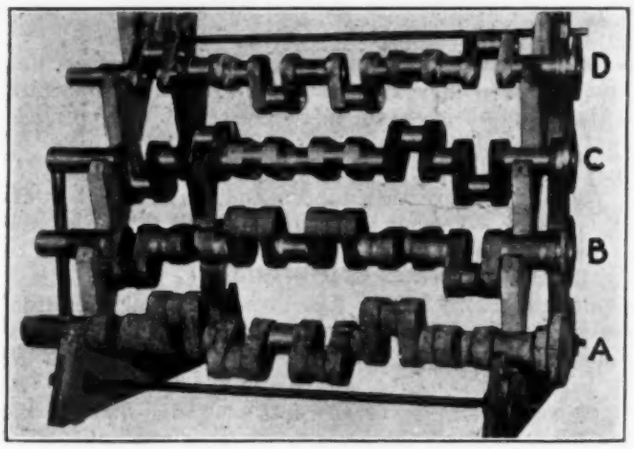

FIG. 1. ROUGH AND FINISHED CRANKSHAFTS

331. It is then sand-blasted and both the shaft and test piece stamped with a similar identification number: In common with all other forgings, a test piece is forged on the chankshaft, being afterward sawed off and marked out for the Stanton impact test and tested for tensile strength as well. If the tests are satisfactory, the crankshaft is then carefully centered.

The first machining operation is to spot grind the center bearings, as can be seen in the lower crankshaft *A*, in Fig. 1. The shaft then goes to a Lo-Swing lathe where the cheeks are rough faced, the main bearings turned, the flanges roughed and the other end rough-turned. This stage is shown at *B*. Next comes the rough-grinding of the flange diameter and the two end bearings. Then the six-flange holes are drilled, and three of them are hand-reamed for locating in the future operations. These holes are so spaced that the crankshaft can only be placed in one position in the carrying fixtures, which avoids all chance of error.

The Grinding Operations

The blocks which index the various throws in the Landis grinding machine are then assembled and the crankpin bearings are all spot-ground. Then the cheek faces of the various crankpin throws are turned on the outside, using the crankpin center, after which all of the crankpin bearings are rough-ground. The main bearings are next rough-ground, leaving the crankshaft as shown at *C*.

The outsides of the crank throws are next milled in two cuts, both the inner and outer ends of the throws being machined in the same manner. The test numbers having been eliminated in machining, are then transferred to the shaft once more.

Next comes the drilling of the main bearing, the fixture being shown in Fig. 2, showing the way in which the crankshaft is held. The drills of various lengths are shown on the bench at the left. The work is done in a Foote-Burt machine which has had the column raised by the sub-base in order to bring the spindle to the correct height for the work.

The crankpin bearings are next drilled in the same machine after which both ends are recentered with

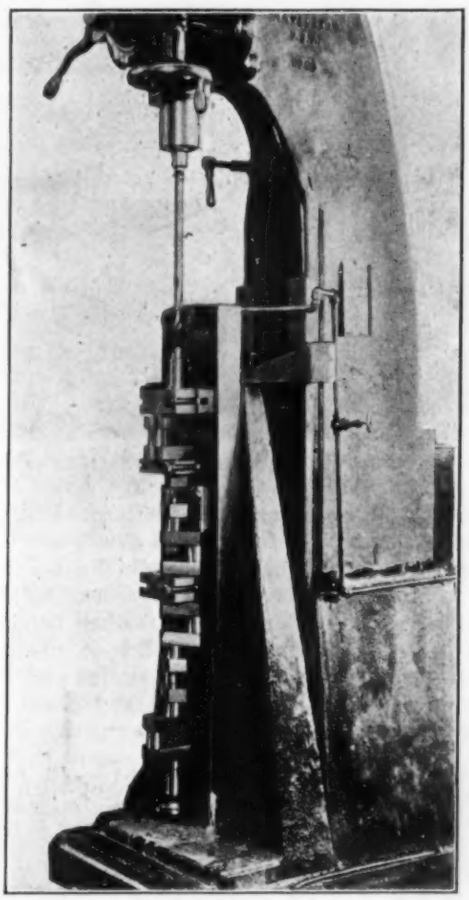

FIG. 2. DRILLING OIL HOLE IN CRANKSHAFTS

reference to the main bearings and to eliminate any change which may have taken place owing to the removal of either internal or external stresses by either the drilling or milling operation. All main bearings

and crankpins are then rough-ground for the second time, the faces of all the cheeks of the crank throws are finished and a 0.3-in. radius is bored in the holes of both the main and crankpin bearings. The hole in the flange and gear end is then bored and reamed taper and afterwards tapped at the outer end. Plug centers are then fitted in each end, and the oil collars on the flange are rough- and finish-turned as well as the back face of the flange being finished at the next operation. Then a taper of 1 in 8 is turned on the gear end and the end turned and necked for threading.

A one-inch radius is then milled on the outer end of the throws and a $\frac{1}{8}$-in. radius on the corner and on the throws. Next comes the drilling of the oil holes in the throws, counterboring the oil holes and tapping the ends for the brass plugs which go in them. After milling a keyway and cutting the threads, the next operation is to finish-grind the main bearings, the flange diameter and the sides of the cheeks, as well as the taper on the gear end of the shaft. Then comes the finished-grinding of all

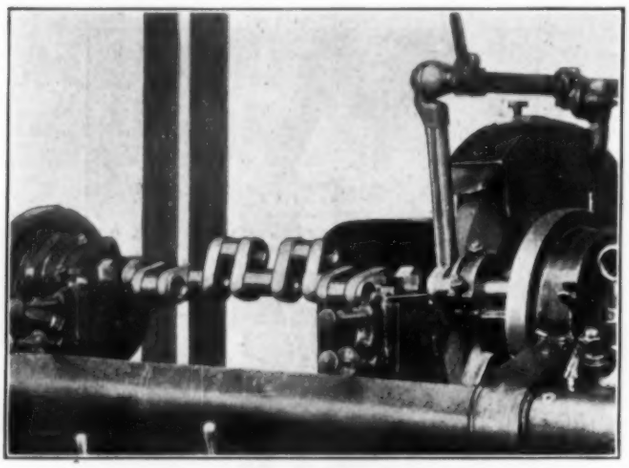

FIG. 3. FINISH GRINDING OF CRANKSHAFTS

crankpin bearings and the other portions. Fig. 3 shows the crankshaft in place for its final grinding.

After a few minor operations, all the bearings are lapped in a special fixture and the oil lead holes drilled in the bearings. The crankshaft is then balanced and the flywheels and clutch rings fitted to it.

The flywheel is then marked for timing and the complete unit of crankshaft, flywheel and clutch ring is mounted in the lathe, the crankshaft running in its own

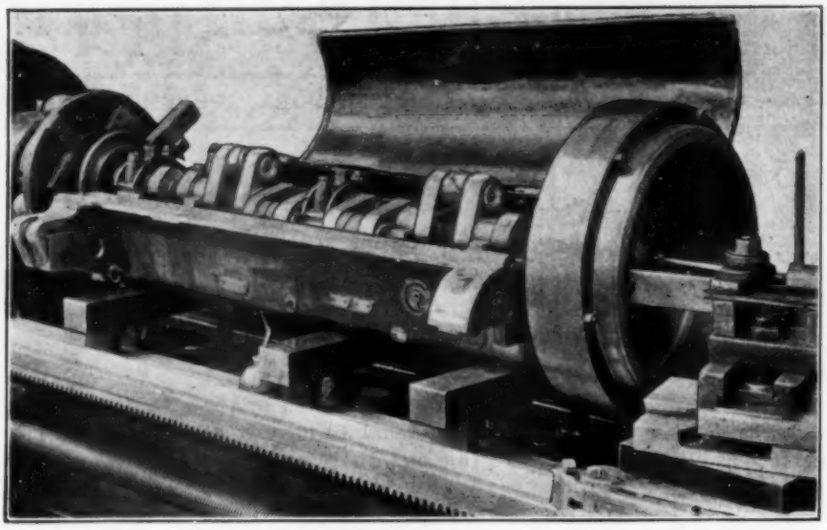

FIG. 4. FINISH BORING CLUTCH RING

bearings while the clutch ring is finish-turned and bored so it will be in exact line with the crankshaft. This operation is shown in Fig. 4 and it will be noted that the crankpins are protected from dirt or injury by a felt wrapping secured with wire clips.

All oil holes are then tapped and the completed unit is balanced. The oil plugs are then all fitted and the completed unit given a running balance test. The crankshaft is then tested with oil under pressure so as to be sure there are no leaks, and the final operation, the marking of the part numbers, completes it ready for the assembly. The finished shaft is shown at *D*, in Fig. 1.

It will be noted that except for rough-turning the main bearings all the bearing surfaces are finished on the grinding machine. The crankpins are ground from the rough forgings. It will also be noted that the grinding is divided between a number of operations, the crankshaft going back to the grinding machine for further reductions after practically each machining operation. The total reduction by grinding is approximately $\frac{1}{4}$ in. in diameter, this being divided among quite a number of operations.

This makes considerable handling of the crankshaft from the grinding machine to the lathe and the drilling machine, but when it is considered that the demand is not expected to exceed eight or ten per week, this extra handling can be practically neglected. The removal of such a large amount of metal also removes the small lines which are very apt to occur in forgings. The method has been found very satisfactory in every way. The final finishing of the clutch cone after its assembly on the crankshaft and the balancing of the completed unit all go to make a satisfactory motor.

The Economics of Production

V. PRODUCTION AND REDUCED DEMAND

By Prof. D. A. McCabe, Ph. D.

WE HAVE now to consider what happens and what action is called for when there is a falling off in demand after a big upward movement. The discussion will turn on prices and costs. Attention will first be given to costs in times of increasing demand.

When demand is increasing it makes its influence on production felt through the offer of increased prices, as was explained in the second article. More goods are demanded at the old price and a higher price is bid for the old quantity. Increased production means increased earnings and a still further bidding up of prices. The higher prices for finished goods lead to bidding for, and so to higher prices for, machinery and supplies of all kinds, for materials and perhaps for labor. For the producers, these are costs. Thus production is put on a new and higher basis of costs. The producers can meet these new costs and keep producing only if the higher prices continue to hold good.

Unfortunately, after a wholesome increase in demand, demand tends to become rash and extravagant. Producers, also unfortunately, may become careless of costs in the face of a demand that seems careless of price. Both prices and costs become abnormally high.

When demand is suddenly checked in an important quarter after such an upward movement, the producers affected find themselves with high costs of production and facing a demand that will not now pay a price high enough to cover those costs. At least the demanders will not pay that price for anything like the full volume of production. The producers who are first affected usually meet the situation by cutting down production. That, as has been explained, leads to a further reduction in demand and so to a still further reduction in production.

The demanders will not pay the old prices and the producers will not run full at the old costs for the prices they can get. What we have then is a deadlock, with little production and a poor demand. We have idle machinery and many men idle or partially idle and yet wanting the goods that are not being produced. This is the situation we have to consider.

The need, obviously, is for a new price basis on which producers and demanders can agree. The demanders find prices too high and will not resume buying until they think prices have been reduced to a proper point. The producers probably discover that a *small* cut in prices will not induce the demanders to come back into the game. They must cut prices considerably to get results. But they will not cut prices deeply unless costs are cut. Production will be resumed only if a new and lower level of costs can be attained.

It takes the producers some time to adjust themselves to this new condition of demand and to get costs down to a point which enables them to offer their goods at a price at which the demanders will take them in good quantities. The readjustment may be delayed through a belief on the part of some producers that the fall in demand is but momentary. After a big upward movement of demand that generates extravagant prices, it is not likely to be so. Things cannot be started then except on a new level of prices from which all artificial and reckless elements have been pruned.

This pruning does not come about automatically. It involves much disagreement as to who shall submit to the pruning first and much hanging back in the hope of escaping the knife altogether or getting off with a small cut. Men are naturally unwilling to take cuts in their prices or rates before *their* costs, whether of living or of producing goods have been cut by those from whom they buy. The conditions under which goods are marketed, whether they are finished goods ready for consumption or goods for use in producing other goods, are so complicated and so full of differences as between one kind of goods and another, that the reductions in price do not come equally or at the same time for all goods. So, necessary readjustments are held up because other readjustments have not been made. If the whole reducing process could be done at once by general agreement all around, the readjustment would take place much more quickly and production on a new basis of prices and costs could be quickly resumed.

This much is certain. The situation we are describing calls for as great and as speedy a cut in costs of production as can be made. All interested in production, and there are few who are not, should bend every energy to reducing costs as much as possible inside each plant. Whether prices of material or rates of wages or salary are cut much or little, all other elements of cost should be reduced to the lowest limit. This is important at all times in the public interest, but it is particularly necessary in a time of falling demand. Every reduction in cost that is not a reduction in earnings helps to bring about the renewal of demand and production and makes reductions in earnings less necessary.

The burden of making the readjustment to a reduced demand falls upon those engaged in production. This will be true as long as men produce to meet the

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demand of others. The demanders may be unreasonable in their attitude. It is largely their fault that prices at times reach the unreasonable levels that cause the trouble. But their refusal to pay those prices any longer must be accepted as a fact and the readjustment made. Until they are convinced that prices have been brought down as far as they can be, they will not play, and without them there will be no game.

Tools Used in the Manufacture of the P & W Adjustable Limit Snap-Gage

II. Making the Measuring Anvils—Many Special Jigs and Fixtures Used—Accurate Grinding Operations—An Ingenious Lapping Device

BY ELLSWORTH SHELDON
New England Editor, *American Machinist*

THOUGH the anvils of the Pratt & Whitney snap-gage are apparently very simple pieces to make, there are in fact many more operations upon them than upon the frame of the gage. Each gage carries four anvils, all of which in addition to the hardening and grinding operations, must be grooved

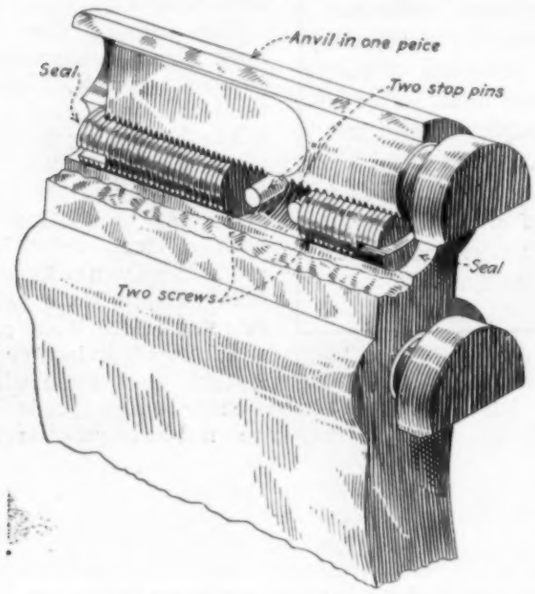


FIG. 13. SECTION THROUGH GAGE, SHOWING ANVILS AND ADJUSTING SCREWS

and threaded for the adjusting screw; beveled upon one side of the head to facilitate the handling of the gage as a manufacturing tool; and finally the gaging surface must be carefully lapped to a perfectly flat and mirror-like surface, accurately square with the axis of the piece.

There are no threads in the frame of the gage. The screws by which the anvils are adjusted to vary the limits or the size of the gage fit closely in the "cut-out" holes previously described as being drilled in the frame; but the threads mesh only with corresponding threads in a groove which is milled lengthwise of the stem of each anvil, this groove being of a size and shape to just complete the periphery of the cut-out hole when the anvils are in place.

There are two adjusting screws to each anvil; and when the latter is in the frame, a screw is run in from each side until it bears upon one of the stop pins placed crosswise of the cut-out hole. Thus the two screws oppose each other and when both are tightened the anvil is locked in place without possibility of the adjustment being altered by accident. Provision is also made for sealing the adjustment so that it cannot be altered by design without leaving evidence of such alteration that may instantly be detected by the foreman or inspector. The perspective view, Fig. 1, shows the construction.

The anvils are made of high carbon steel and are roughed out on the screw machine, no special tools being required. The second operation is the rough-grinding in which the diameter of the stem is reduced to within 0.008 in. of size. The gaging surfaces are then shaved in a Pratt & Whitney shaving-machine.

The first operation with which this article is concerned and for which special tools have been designed is the milling of the thread groove for the adjusting screws. This groove completes the periphery of the cut-out hole in the frame, so that when the screw is in place it bears upon the tops of the thread for its full circumference but meshes with engaging threads only upon that part that is in contact with the stem of the anvil.

The groove, however, is not a part of a true circle. An idea of its contour may be gained from the drawing, Fig. 13, which shows the groove to be cut deeper at the center than the true radius would require, the object being to break up the threaded surface into two sections. This method makes the threading operation much easier to perform because chips from the tap are broken and the deeper portion of the groove provides a channel for the cutting lubricant, lessening the liability to clog.

The milling operation is performed on a Pratt & Whitney semi-automatic milling machine, fitted with a special reversing type of fixture to hold four pieces, two of which are milled at a time. Two form cutters are mounted on the arbor of the machine, and two pieces of work are held by clamping them against opposite sides of a dovetailed piece that is in effect a double V-block with the "V" disposed at an angle to the line of pressure.

The lower sides of the "V" are horizontal, or parallel to the line of pressure of the clamps and thus present a positive locating point directly opposed to the pressure of the cutters. The other side of the "V" stands at an angle of 60 deg. and tends to force the work solidly down on the flat side. The two clamps are drawn together by one bolt passing clear through them and tightened by means of a single cam lever that, at the time the clamping is done, is convenient to the right hand of the operator.

The fixture, shown in Fig. 14, is reversible, so that

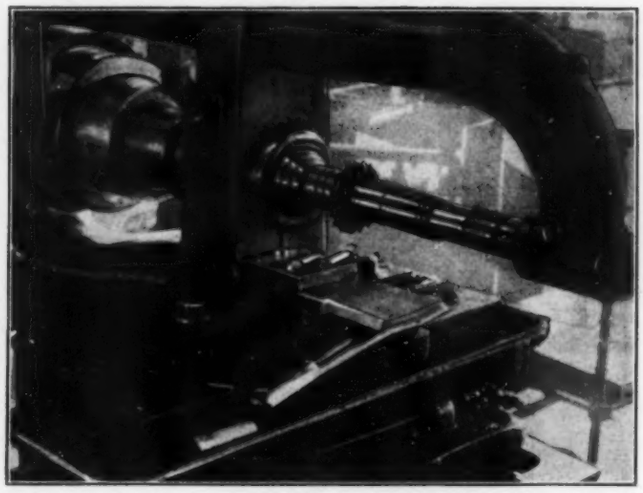


FIG. 14. MILLING THE GROOVES FOR THE THREAD. FIG. 15. BEVELLING THE HEADS

the operator may unload, clean out the fixture, and place two pieces of work, while the milling operation is going forward on the other two. When the cut is completed the machine table automatically returns to the starting point and starts forward again, the operator meanwhile unlocking the revolving top of the fixture, turning it 180 deg. and relocking it by means of the lever *A*. In this way the milling operation is practically continuous.

There are five different styles of anvils, including different sizes and shapes of head, which must be milled to conform to the requirements. One such operation is shown in Fig. 15. There are no special fixtures for this operation, which is done in a hand milling machine, except the fitting to the lever operated vise of a special jaw in which there is a groove to match the contour of the stem. The work is thus held in a vertical position and with the longitudinal groove of the stem in correct relation to the line of travel of the machine table.

Two cutters are used on the arbor, a side milling cutter and a bevel cutter placed together with the teeth interlocked so that one side of the circular head is flatted off and the bevel milled at the same time.

Another form of anvil with what is called the offset head is milled on a Pratt & Whitney cam milling machine as shown in Fig. 16. The offset head is used only on the smallest size of the gage and is made in this way because anvils with the regular head could not be assembled in the small frame.

The cutting of the threads in the groove of the stems, which ought to be a difficult operation, is really a very simple one. A small fixture is made to hold two of the anvils at once with the grooves toward each other, so that except for the interruptions caused by the slight distance between the two pieces and that made by the deeper portion at the center of each groove, a circular hole is presented to the tap.

A plate at the top of the jig locates the work by the flat portion of the head so that there is no possibility of getting the pieces in a wrong position. The entire jig is small enough so that the operator may hold it in his left hand while the tap is run through. Two screws are provided, however, in the table of the tapping machine which hold the fixture loosely; allowing it to float under the tap, though preventing it from turning around. A stream of oil is delivered directly upon the top of the work and the tap is therefore flooded with lubricant, washing out the chips as fast as they form and thus preventing snagging and breaking of the taps. This operation is shown in Fig. 17.

The tapping is the final operation before hardening. When the pieces are returned from the hardening room they are as hard as is practical to make them, the tempering being carried only to a degree sufficient to relieve the strains in the steel.

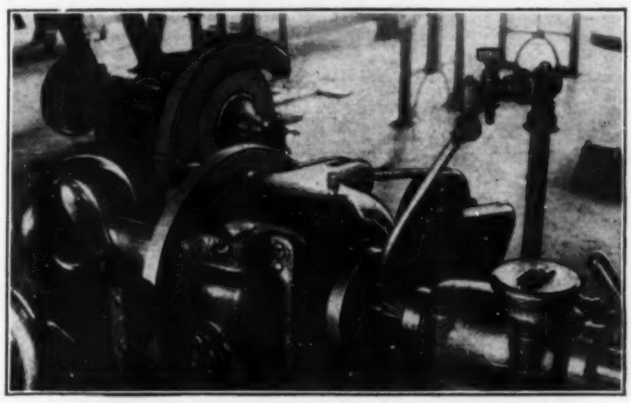


FIG. 16. MILLING THE OFFSET HEADS

The first operation succeeding the hardening is to finish-grind the stems. This is done with a rather wide faced wheel upon the standard Pratt & Whitney cylindrical grinding machine shown in Fig. 18. The limit allowed upon the stems is two "tenths" and the time, including cleaning out one center in each piece, is one minute and fifteen seconds. Only the tail center is used, as the work is driven by the head of the anvil, for which special collets are made. Several minor operations follow the above, such as grinding the rear ends of the stems, an operation performed by hand on

FIG. 17. THE TAPPING OPERATION

a disk wheel; stoning the corners and grinding what is left of the periphery of the head, for which operation the work is held by the stem in a spring collet, a nominal limit only being required.

For grinding the gaging surface, which must be accurately square with the axis of the anvil, a number of pieces are mounted in the jig shown on the P. & W. vertical grinding machine in Fig. 19 and in detail in Fig. 20. This jig is a disk of machinery steel with semi-circular grooves of a depth equal to half the diameter of the stems milled across the periphery. A flexible band of spring steel fits over the outside after the pieces are placed in the jig and drawn tight by means of the clamp that is a part of the band. One or two passes of the work under the wheel serve to bring the heads to the required thickness.

Each piece is pushed down until the under side of the head bears upon the disk, when the band is tightened by turning up the thumbnut of the clamp. Though this jig is very simple, it demands accurate workmanship, for any variation in depth of the grooves or of the size of the stems would leave one or more of the pieces loose to spin around under the wheel and destroy the grinding face.

After grinding the face the bevel is ground on a bench lathe, the set-up being shown in Fig. 21. This work is done by the man who attends the lapping machines, these machines being practically automatic in operation and requiring attention only once an hour or so. As the anvils at this stage are finished to length within very close limits and the spring collet is fitted with an end stop for locating the work, the operation is quite rapid.

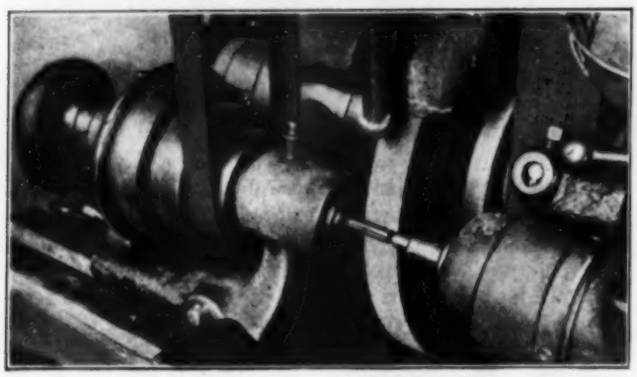


FIG. 18. FINISH-GRINDING THE STEMS.

FIG. 19. GRINDING THE HEADS BEFORE LAPPING

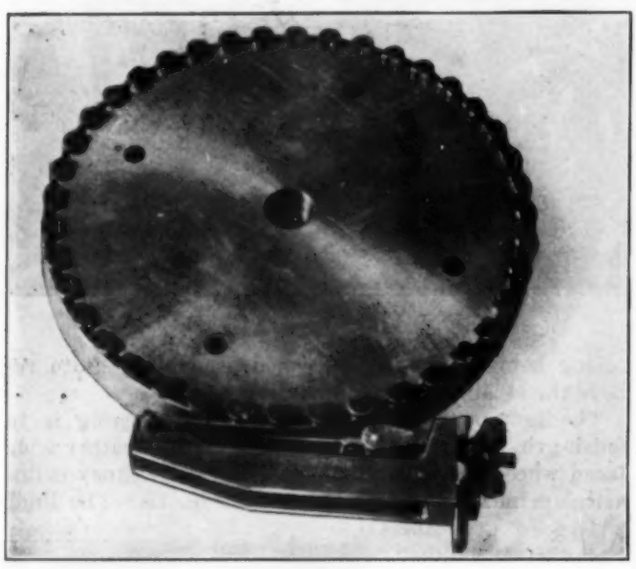


FIG. 20. THE JIG THAT HOLDS THE ANVILS IN THE GRINDING POSITION.

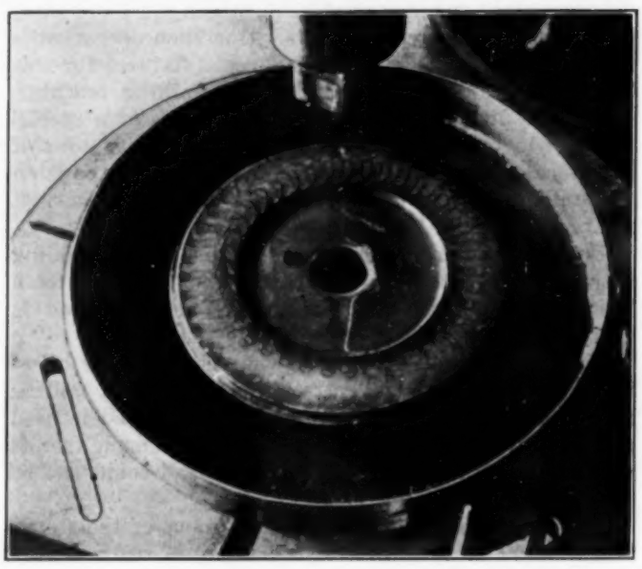


FIG. 22. THE LAP

The holding jig is the same in principle as that used in the lapping operation though it is not the same jig.

As anvils are made in four different sizes to complete the range of the gages from 0 to 12 in. there are necessarily four of the disks *A*, Fig. 20, each disk requiring a band and clamping device of its own. The grooves extending across the periphery of the disk are accurately milled to fit the respective stems and spaced as closely as it is convenient to set the pieces. To load the jig the disk is placed on a surface plate, the band, with the clamp loosened, is placed over the disk, and the grooves filled with the pieces to be ground.

The final machining operation, and the most unusual and interesting one, is the lapping of the gaging surfaces. The tools and the set-up are shown in Figs. 22, 23 and 24. The machines used for the operation are standard drill presses, but these are used only because they were convenient. The tools are complete in themselves, requiring only a means of rotating them, and this means is supplied by the drill press.

The lap is shown in Fig. 22, the work having been removed for intermediate inspection. It is of cast iron, with the annular lapping surface of such diameter, both

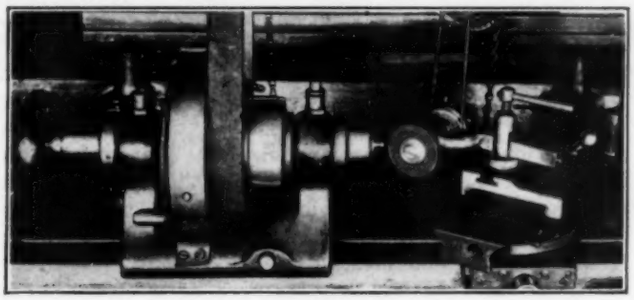


FIG. 21. GRINDING THE BEVELED CORNER

inside and out, that the pieces just pass the edges at the extremes of movement and thus prevent the wearing of ridges. The lapping medium is a special mixture of very fine emery, floated in kerosene. In Fig. 22 the holder and work have just been lifted and the path of the work over the lapping surface is clearly outlined in the lapping mixture.

In Fig. 22 the lap is shown mounted inside a circular pan of galvanized iron the purpose of which is to keep the emery and oil from running down on the table of the drill press. In Fig. 23 one of the devices is seen at work in another drill press upon which no drip pan has yet been placed. Fig. 24 shows the loading plate *A*, several of the disks *B* and two of the clamping bands *C*. As has been stated, the grinding jig shown in Fig. 20 is the same in principle, but in Fig. 24 it will be noted that the disks have ears upon one face while that shown in Fig. 20 is a plain flat disk.

Any surface plate, or even a bench, is all that is required to support the disk in Fig. 20 but for the lapping a special loading plate is necessary, as accurately made as the tools themselves. To load one of the disks for lapping it is placed upon the bench, face up as at *B b*, and the anvils disposed within the clamping band exactly as in the grinding operation. The band is then brought to a bearing by turning the thumbnut of the clamp, but is not clamped tightly.

The disk is then turned over and placed upon the loading plate where the face of the disk bears upon the raised central portion of the plate. It is clamped thereto by the thumbnut on the central stud. With a wooden mallet or a piece of lead the operator now taps the stem of each anvil until he is sure that all of them bear firmly against the corresponding part of the loading plate.

Great care must be exercised in this loading operation to insure that every anvil bears evenly upon the loading plate, for if any one should protrude even slightly beyond the others, and run upon the lap in this position, it would not only wear hollows in the lap but none of the entire loading would be lapped square with the axis.

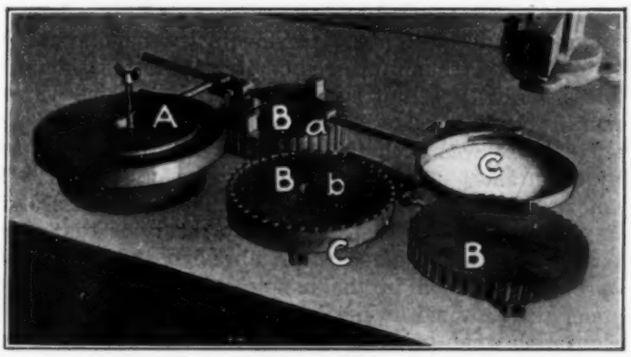


FIG. 24. THE TOOLS USED IN THE LAPPING OPERATION

The band also must be carefully placed, feeler gages being employed between it and the loading plate as the clamp is finally tightened, for if it were tilted with relation to the disk it would encourage the anvils upon the lower side to work away from the lap.

The purpose of the ears upon the back of each disk is made apparent by the view *B a*, where the lifting rod, by means of which the loaded plates are handled, is shown in place. The loaded plate is carefully deposited upon the lap as in Fig. 23 and the spindle of the drill press is brought down until the offset pin in the chuck enters the bronze bushing at the center of the disk.

The pin in the chuck fits very loosely in the bushing, so that any inaccuracy of alignment that may exist in the drill press is not transmitted to the device.

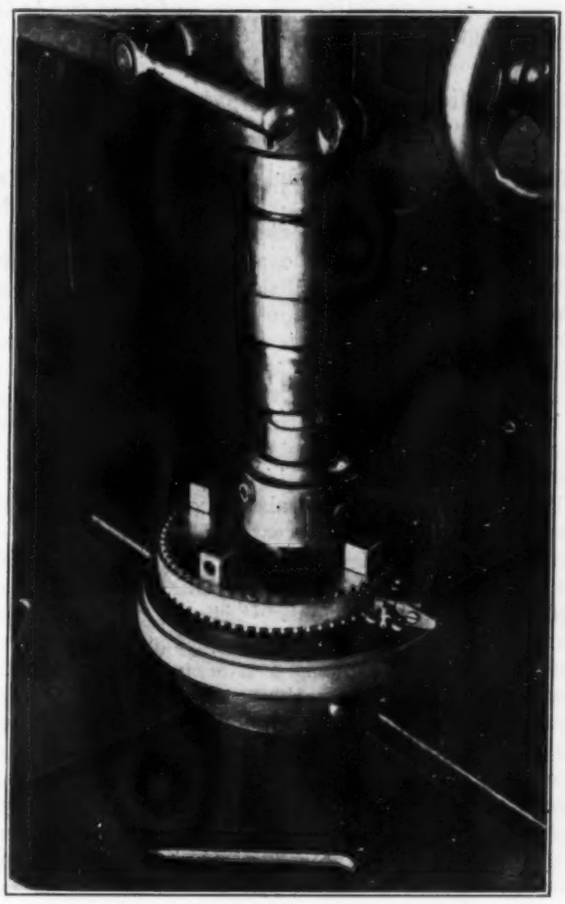


FIG. 23. FINISH-LAPPING THE HEADS

As the drill press spindle slowly revolves it imparts a circular motion to the loaded holding plate, the path of which is clearly indicated in Fig. 22. There seems to be no good reason why the disk with its load of anvils should rotate about its own axis, but as a matter of fact under ideal conditions of the lapping medium it does so rotate slowly, requiring several minutes to complete a revolution, though the relative movement of the drill press spindle, and consequently the circular motion of the disk, is about 60 per minute.

Peculiar as it may seem the direction of this slow rotation does not always coincide with that of the drill press spindle; it not infrequently goes backward, but so long as it rotates evenly no attention is paid to it. When the rotation in either direction takes place intermittently or in a series of jumps it indicates that somewhere in the lap is a particle of abrasive larger than the

rest, and this condition requires immediate investigation or the result will be deeply scored work.

Sometimes the disk does not rotate at all and while this condition does not apparently affect the quality of the work, it tends to wear the lap unevenly and either more oil or more abrasive will be added until the floating movement is re-established.

A newly loaded disk is allowed to lap only a few seconds before it is lifted and the work examined with a glass, by which means the operator may determine if all the pieces are bearing evenly. If any discrepancy exists in this respect it is corrected, and the disk returned to the lap for another short period. When the operator is satisfied that each anvil is bearing its proper share of the weight the device may be left to itself while he attends to other duties. A period of from one to two hours is required to complete the lapping.

Qualifications for a Cost Accountant

BY L. L. THWING

Why is it not easier and better to take a bright young man who has had a reasonable amount of shop practice and teach him cost accounting than it is to take an office man for the same purpose. The shop man will bring with him all sorts of pertinent and valuable information that the office man does not know. There is no reason to believe that the shop man will not be able to learn to allocate and pro-rate as well as the office man, although the accountants would have us believe that cost accounting is an obscure and deeply involved science only to be handled by, at least, a correspondence school graduate.

The general complaint about cost systems is that they do not give accurate costs. I do not suppose that this inaccuracy is due to any errors that develop after the figures have left the shop and have been delivered to the cost department. It is reasonable to suppose that the clerical work of collating the shop figures is done correctly. If this is a true assumption, the real trouble is in the figures that are delivered to the cost department, over which the department has no control, but in which they should be able to detect the ear marks of error. For example, I had occasion to go to the cost department of a large machine shop for certain figures, and while there noticed a list of machine-hour costs on the desk. While the information for which I asked was being dug out, I turned over the leaves of the book curiously until I came to the record of one of the departments that I was familiar with. I found that the machine-hour cost for a certain 24-in. drill was $1.70, and for a 48-in. boring mill next to it, $1.85. These figures are quoted from memory, and may be exaggerated, but I was impressed by the fact that the machine-hour rate for a $3,000 machine should be so slightly in excess of that of a $300 machine. To a layman they seem very disproportionate, and I believe that they are. Now, whether or not the cost department figured these rates, it is at least responsible for them, and there should be someone in that department whose training qualifies him to pass on such problems. The foundry cost system in this same shop is operated by the foundry superintendent. He informed me that he was not able to get the figures that he needed from the cost department without wading through too much stuff, and so he pursuaded the front office to let him take it over, and he had operated it with the aid of three clerks for some time to the satisfaction of all concerned. This was in a shop employing 3,000 men, having a large proportion of special work and a cost department of about 50 clerks. I asked the cost accountant if he did not think that there should be at least one man in an organization of that size to represent the shop end of the cost system and to give all his time to checking and following up the cost records made in the shop, and he agreed with me that it would be a good idea.

One of the constructive features of a cost system is to point out unusual or presumably excessive costs. Faults in manufacturing methods can be checked at two points; when the costs are assembled, and when the methods are inspected. The old one-man machine shop depended on the latter method.

Many shops have, in the larger departments, a cost clerk who collects the time and material records for the cost department, in which the clerks are not infrequently girls, or men with an office rather than a shop training. Now, if it were the general practice to employ shop-trained men in these positions, even at an increased cost, there would be certain improvements in shop records, and a possible detection of various errors before it was too late to correct them. For example, if a lathe hand should charge up work on a rectangular piece, an investigation could be made then and there to see if that was a mistake or an exception to the usual shape of lathe work. If 50 per cent more time than usual was charged to a piece of routine work, an investigation at once might bring out the fact that the workman was taken off that particular job for a day, and forgot to deduct it from his regular time.

In brief, it is of little advantage to take incorrect figures to the cost department, as no subsequent manipulation of results can ever correct the errors. The place to catch them is as near the source as possible, and as soon as possible. A shop-trained man is more likely to do this, because there are a thousand and one bits of unwritten shop practice that collect in his head along with the cast-iron dust. You hardly ever see a shop man who reaches out for any sort of office work, but it is not uncommon to see the office assume, either by necessity or presumption, various functions that are best left to the operating end.

Are Hollows Worn in Hammer Handles?

BY O. L. LIPPERT

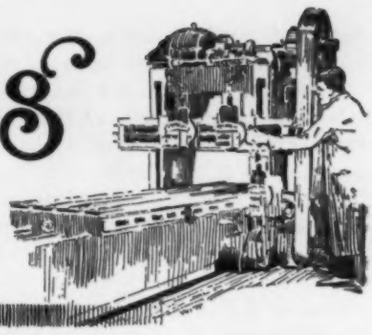
The article by L. L. Thwing on page 980, Vol. 54, of *American Machinist*, concerning the wear of hammer handles brings to mind a case which I noticed some time ago.

I was using a light hammer on a production job. The hammer had been used by some other man before I took it and I found a slight depression in the handle where the end of the thumb pressed on it. At first, I thought this hole had been ground in but after some three month's constant use, the hole was much larger.

The work was such that it required the operator to lay down and pick up the hammer between 350 and 400 times an hour and was just greasy enough to cause dirt and grit to stick to the hands. My theory is that this grit on the thumb acted as an abrasive and gradually wore a depression in the handle. Why it wore only under the thumb I do not know, unless the pressure of the thumb when gripping the hammer was greater than the rest of the hand.

Metal Cutting Tools.

By A.L.DeLeeuw



XV. Generating Tools—Gleason Bevel and Spiral Bevel Gear Planing Tool—Fellows Gear Shaper Cutters—Single and Multiple Thread Hobs

GENERATING tools are tools of definite form which give a piece of work a shape or profile different from the shape of the tool itself by the nature of the relative movements between work and tool. In other words, the shape produced depends on the shape of the tool as well as on the movements

FIG. 231. FINISHING TOOL FOR GLEASON GENERATOR

made by work and tool. One of the best known examples of this class of tool is the one used in the Gleason bevel gear generator. There the tool itself is of the simplest possible form, but produces a tooth shape of an entirely different outline and differing with the number of teeth of the gear produced. We will not go into the intricacies of generating different shapes, except in so far as certain qualities are required in the tool to make it act properly. In many cases, though not in all, the shape generated is such that a tool of simple shape combined with simple mechanical movements will produce the desired result. Instances of this kind are spur and bevel gears. Such gears can be generated by a tool of which the active edge is a straight line and which requires only straight line and circular movements.

Fig. 231 shows the tool used on the Gleason generating bevel gear planer and Fig. 232 shows its details. It will be noticed that in cross-section one side of the tool is ground to an angle of 14½ deg. This is the generating angle, and this angle might be anything within the practical limits of the requirements of the gear. Gears cut with this tool will mesh together properly, and so do gears cut with a tool having an angle of 15 or 20 deg. One tool is sufficient for the entire series of gears, provided the generating angle remains the same. Broadly speaking, it would be possible to make a pinion of 12 teeth and of the finest imaginable pitch, or a gear of 180 teeth of the coarsest pitch, both with this same tool. However, as a matter of fact, this is not done. The tool with a narrow enough front to cut the fine pitches would be too delicate for the coarser pitches. Nor would it be practical or economical to try to cut the smallest gears on a large gear planer and, of course, it would not be possible to plane the large gears on a small gear planer. Such practical considerations, then, make it necessary to have a few tool sizes for a given generating angle.

The generating motions are entirely in the machine, and the tool is of the simplest possible section, as is clearly shown in the illustration. Furthermore, the cutting motion is a straight line movement, so that it is possible to grind the front end of the tool to any desired angle suitable for the best cutting action without affecting the shape of the generated gear. In other words, it is possible to give this tool any desired clearance and rake. We have seen, when discussing formed milling cutters, that to grind a given formed cutter with rake changes the shape or contour of the piece made by that cutter, because the piece produced will fit successive radial sections of the cutter as it passes through the work. With the Gleason tool, however, the shape generated does not correspond at all with the shape of the generating tool, and so long as the cross-section of the tool remains the same, the generated gear will not be affected.

It was remarked that all gears generated by the same tool and on the same machine, or rather on the same type of machine, will run together in the proper manner. Of course this statement should be modified somewhat, because in a bevel gear different diameters of the same gear have different pitches. Bevel gears may be imagined as being cut from a sphere and the diameter we refer to here is the diameter of that sphere. The length of face of the gear tooth is part of a radius of that sphere. The movement of the

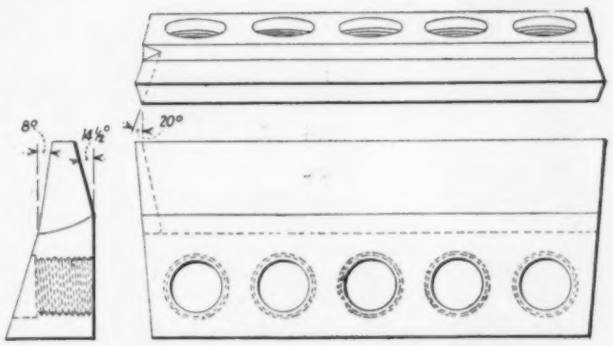


FIG. 232. DETAILS OF GLEASON TOOL

generating tool is along one of the radii. However, the manner in which the tool gets from one end of the gear face to the other is of no importance and

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does not need to be a straight line. If we use the straight line for the path of the generating tool we will obtain bevel gears as we know them. But any other motion might have been used, provided that the same kind of movement is used for all mating bevel gears. We might have gone from one end of the tooth to the other by a broken line, in which case we would have obtained what might be called a "bevel herringbone gear." Or we might have used a snake-line, in which case the gears would run together just as well, provided that we use the same line of movement for all gears generated. Again, we might have used a circular movement for the cutting action of the generating tool, and if we use the same circle of cutting motion for all the gears of a system they will again mesh together properly. Under those conditions we obtain what is called a spiral bevel gear.

If we go from point to point along a tooth of a spiral bevel gear we will get constantly changing conditions of shape and generating angle, etc. But this does not affect the proper running together of two gears. All that is necessary in order to produce again a system of mating gears is to preserve the shape of the generating tool, to have always the same generating movements of the machine and always the same nature of cutting movement of the tool. (The machine itself does not change except by wear, and we are not concerned here with this phase of the matter.) The cutting tool has naturally a tendency to change its shape by wear, and the cutting motion might be changed by placing the cutting tool nearer to or further from the center of the circular movement. Therefore, if we wish

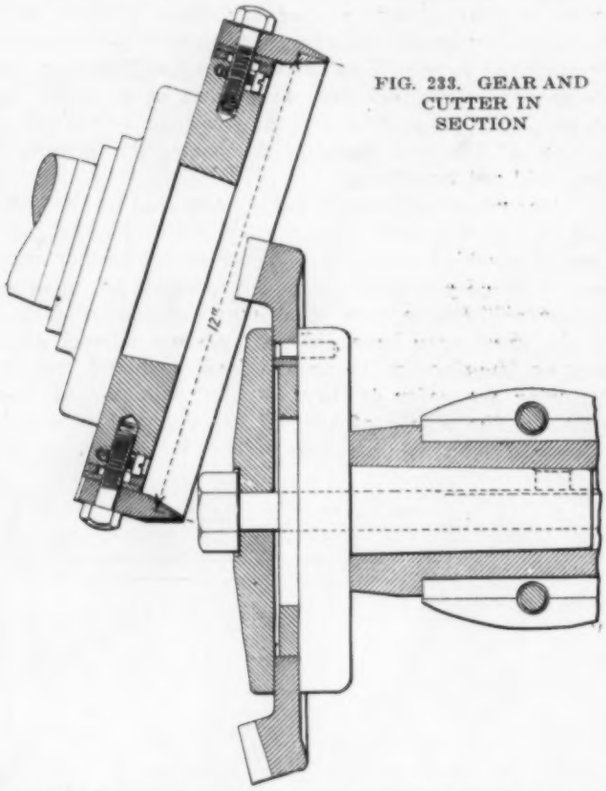


FIG. 233. GEAR AND CUTTER IN SECTION

to obtain proper results with this kind of tool we must be absolutely sure that we retain the shape of the tool and its distance from the center.

Fig. 233 shows a gear to be cut and also the cutter in section. The cutter contains two kinds of blades: Some cutting on the outside and some on the inside, for the purpose of generating the two sides of the tooth gap. They are made adjustable in their radial position by means of a tapered wedge and a fine adjusting screw, and they are clamped in position by means of a heavy screw. Fig. 234 shows the construction clearly. The cutter has the general appearance of a face mill.

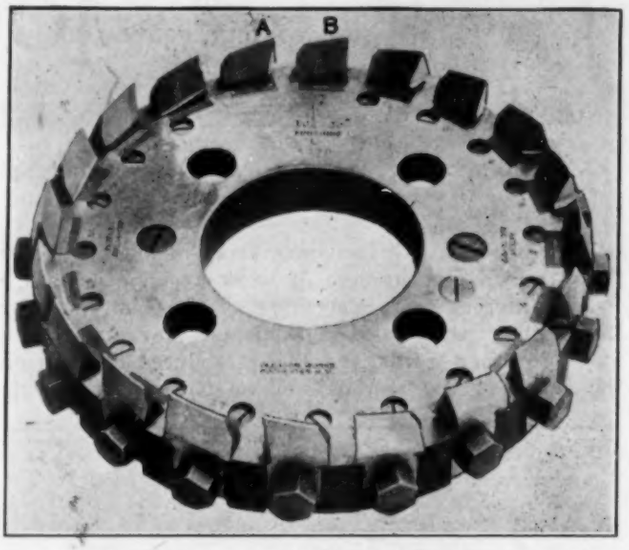


FIG. 234. GLEASON SPIRAL BEVEL GEAR CUTTER

It is made with 20 teeth—10 for outside and 10 for inside cutting. Each individual tooth is made like the teeth of a formed mill, so that they can be ground on the face without losing the proper cross-section. Two of the teeth, marked *A* and *B*—one for inside and one for outside cutting—are non-adjustable and are used for reference when the other teeth are ground and adjusted. In this manner it is possible to maintain the proper relation of the teeth with each other, and therefore the two main elements which must not be disturbed, i.e., the generating angle and the distance from the center, are maintained.

Another tool of simple shape capable of producing an entire system of gears is the Fellows gear cutter. In both the Gleason and the Fellows machines the generating tooth is a rack tooth of which the shape is essentially a straight line. As we have seen in the Gleason machine the rack tooth is a part of a circular rack or, as it is called in that case, a crown gear. In the Fellows gear shaper the base of the generating system is the rack tooth, but in this case the rack tooth is not used for generating the various gears.

In a system such as the involute system of gears, any two gears generated by the same rack will run together properly, and vice versa, any gear generated by the rack can be used to generate any other gear or even the rack itself. Working on this principle, the Fellows system employs a gear as its generating tool and this gear had been generated in its turn by a rack tooth. It is well known how a grinding wheel is employed as the generating rack tooth, thus permitting the finishing of the tool after grinding.

As used in the machine, the generating cutter and the blank to be cut are rotated together as if they were two gears in mesh with each other, and the cutting motion of the tool is merely a motion up and down, such as that of a slotter tool. If the original rack tooth had been used to generate the gear, then this tooth would have to be returned to its original position

after a single tooth of the gear had been generated, and then the gear blank would have to be indexed. As one of the chief advantages of the system is the avoidance of inaccuracies by indexing, one of the greatest advantages of this system would be lost if a single rack tooth were used as tool. Even if a section of rack were used instead of a single tooth, the same difficulty would remain. In that case several teeth might be generated before it would be necessary to return the rack to its original position, but in the course of time such a return would become necessary and we would have to index once more.

Fig. 235 shows a Fellows gear cutter. Fig. 236 shows the same cutter in section and the manner in which it is held on its arbor. One face of the cutter is a plane surface and the opposite face is conical.

The purpose of this conical surface is to give rake to the teeth of the cutter. The illustration shows the amount of rake to be 5 deg. However, Fig. 237 shows that this 5-deg. rake only exists in the direction of arrow No. 1. With conditions such as shown in the figure, that is, a tooth occupying almost the entire length of the radius of the cutters, there would also be a certain amount of rake in the direction of arrow No. 2. On the other hand, the amount of rake at arrow No. 3 would be exceedingly small, we might say negligible; and this is even more so when the proportions of length of tooth and diameter of cutter are as they are actually made. Most of the heavy cutting, or roughing, is done at the front of the tooth, while the finishing is done with the side. We see, then, that the cutter as made has some rake where it is most beneficial.

A first glance at a Fellows gear cutter gives the impression that the cutter is made on the same principles as a formed milling cutter; that is to say, it looks somewhat as if it were backed off, but this is not the case. The method of generating the cutter makes the top of each tooth smaller in section than the bottom. We might say that the teeth of the cutter resemble somewhat the teeth of a bevel gear; with this exception, however, that the outline of the tooth remains the same after resharpening, though the thickness of the tooth changes. This, however, does not result in a faulty gear being cut. If the cutter were used in the same manner in which a milling cutter is used, in other words, if the shape of each tooth were reproduced in the work, the gashes cut after successive sharpenings would become gradually narrower. However, this cutter is used as a generating tool and the nature of the generating motion, combined with the nature of the generating curve, is such that the gear cut after successive sharpenings of the cutter will have the same qualities as the gear cut with a new cutter.

There are, then, very few items which must be taken care of in the sharpening of such a cutter. It is only necessary to mount it centrally on a stud which should fit the hole in the cutter, and either to set the cutter or else the grinding wheel to the given angle. The sharpening is preferably done on what is called a ring grinder, though it can be done on any universal grinding machine. If the cutter is not set to the correct angle, the outline of the teeth will be somewhat modified, but a small variation of the angle, such as might occur in practice, would produce so little distortion of the outline that it would not be noticeable in the result.

Fig. 238 shows a Fellows gear cutter used for helical gears. Due to the fact that the teeth of the cutter must be set to the angle of the helix to be cut in order to have clearance, each tooth must have its own cutting surface, as shown in Fig. 238. As a consequence it is no longer possible to sharpen by the method described above, but each tooth must be sharpened separately somewhat like the teeth of a milling cutter. With such a cutter it becomes quite important to have the rela-

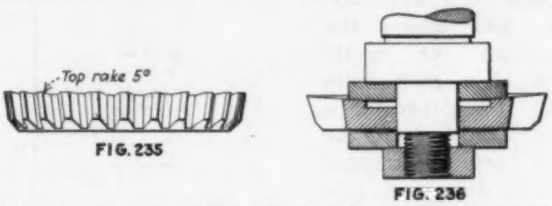


FIG. 235 FIG. 236

FIGS. 235 AND 236. SIDE ELEVATION AND SECTION OF FELLOWS CUTTER

tion between grinding wheel and cutter right. The spacing also becomes an important item. As ordinary dividing mechanisms used on cutter sharpening machines are usually not made with the same accuracy as the cutter to be sharpened, such devices should not be used. It is better to grind each tooth by a solid tooth rest, grasping around the body of the tooth to be sharpened. A spring tooth rest would not be permissible.

When the Fellows cutter is used for generating spur or helical gears of which the tooth shape is the involute, no inaccuracy is introduced by the fact that the top of

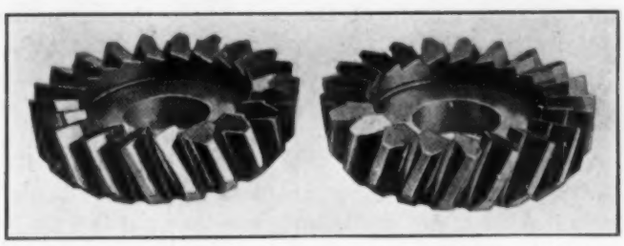


FIG. 238. FELLOWS CUTTER FOR HELICAL GEARS

the tooth is somewhat narrower than the bottom; but when similar cutters are used for other shapes, such as sprockets or ratchets or any shape different from the involute, this condition no longer prevails, and it becomes necessary to make the cutter along the same principles as the formed milling cutter; in other words, if the cutter is resharpened on a plane parallel to the original

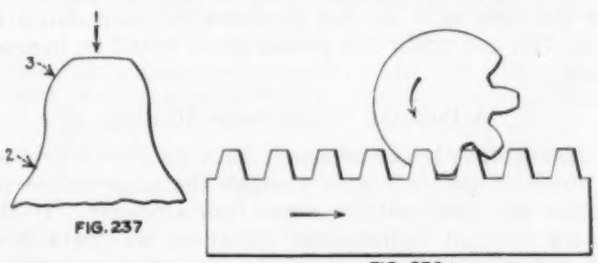


FIG. 237 FIG. 239

FIG. 237. DIAGRAM TO SHOW RAKE LIMITATION OF FELLOWS CUTTER. FIG. 239 USING A RACK AS A GEAR CUTTER

plane of cutting edge, the same cross-section of tooth must be produced.

The generating action of a hob depends on the same general principles as that of the Fellows cutter. It

was mentioned that the real generating shape used in the Fellows gear shaper is the rack, but that for certain reasons the rack was not used in the gear cutting machine, but was used to generate a cutter which in its turn would generate gears. It was also pointed out that the reason the rack itself was not used lies in the fact that we would need a great length of rack for a gear with a considerable number of teeth, and that the whole procedure would become impractical. Fig. 239 shows the condition we would have if a rack were used to generate a gear. The teeth of the rack are distributed side by side here, just as in an ordinary rack. However, these cutting teeth might be distributed in a different fashion such, for instance, as shown in Fig. 240. In this figure the first tooth A_1 is shown about to enter the gear, and also (but in dotted lines) in the position it would occupy after it had passed through the gear. By this time, the second tooth B is just about ready to enter the gear. Before we make it enter, we will rotate the gear and move the rack sideways as if they had meshed together, bringing the second tooth of the rack above the centerline

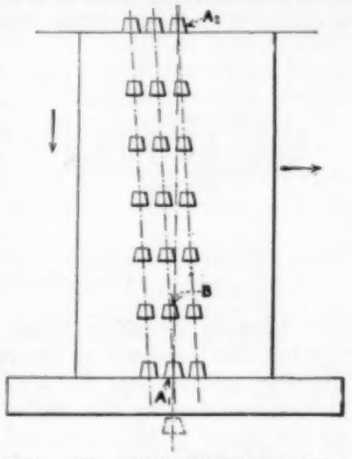
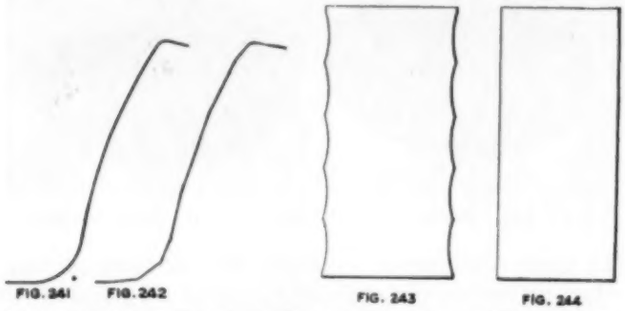


FIG. 240. ELEMENTARY DIAGRAM OF HOB PRINCIPLES



FIGS. 241 AND 242. DESIRED AND ACTUAL CONTOURS OF HOB-CUT TEETH. FIGS. 243 AND 244. ACTUAL AND THEORETICAL SECTIONS OF HOB-CUT GEAR TEETH

of the gear. We then stop this motion and proceed with tooth B as we did with tooth A_1. The result would be the same as if we had employed the rack shown in Fig. 235, and again this arrangement would be impractical.

A Possible Theoretical Method

However, it is not necessary that we should first let a tooth of the rack pass through the gear before we rotate the gear and move the rack sideways. If the gears were of infinitesimal thickness we could have brought the cutting teeth of the rack as close together as we might wish to, and then we could have given the rack a downward motion at the same time that the gear rotates and the rack moves sideways. Nor would it have been necessary to have only one rack tooth in each horizontal plane; we might have had two or three or even more. And as long as we do not have so many rack teeth that some of them will fall entirely outside the gear, each tooth would have done some part of the work.

As a matter of fact, we will never have a gear of infinitesimal thickness, and as soon as the thickness is appreciable at all it will take the rack tooth some time to pass through the thickness of the gear. During that time the rack has moved sideways a small amount and consequently all layers of the gear with the exception of the infinitesimal top layer will be acted upon by a tooth which stands off the center.

Practical Method of Gear Cutting

As we mentioned before, such an arrangement would not be practical, but it leads to one of the most practical methods of gear cutting in existence. If tooth A_1 (Fig. 240) is in the center of the gear we will finally get a tooth A_2, which is directly above the center. If there were three teeth in each group of teeth and we started with the central one of the first group, this tooth A_1 will not be the center of its group, but will be the tooth to the right of the center. If we should cut the rack off at this point A_2, as shown by the heavy line, and then roll it into a cylinder, and if then we should rotate the rack instead of moving it downward in a straight line, but giving it otherwise the same movements which the rack had, we will obtain exactly the same result.

The rack rolled into a cylinder is a hob. In order that a hob shall make a perfect gear (we mean here a theoretically perfect gear) it would have to have an infinite number of teeth per revolution and the gear would have to be of infinitesimal thickness. These conditions cannot be fulfilled and as a result a gear cut by a hob is not theoretically perfect. This fact is generally recognized, but many people do not realize how very small the errors are, caused by this departure from ideal conditions.

The fact that we have only a limited number of teeth per turn of the hob causes the shape of the gear teeth to be a compound line made up of a number of short straight lines and not a perfect curve, and whereas the shape should be somewhat as shown in Fig. 241, we will find it to be somewhat as shown in Fig. 242.

Imperfections too Slight to Be Serious

The fact that the thickness of gear cut for one revolution of the gear is not infinitesimal, but may amount to as much as $\frac{1}{8}$ in., causes the section of the gear to appear as shown in Fig. 243 instead of the shape shown in Fig. 244 (which is as it should be). The waves in Fig. 243 are grossly exaggerated; though visible to the naked eye, the depth of the impressions will be a very small fraction of 0.001 in. This depth is not the same all over the profile of the tooth, that is, it may be different at the top of the tooth, at the pitch line, and at the bottom of the tooth, but, even with the coarsest feed which can be used in practice, the depth of the impression will be exceedingly small at any point. Similarly, though the profile of the tooth is actually formed by a number of straight lines, they will appear to the eye and to the sense of feeling as a continuous curve, unless the number of teeth in the hob is unusually small or unless the hob is not long enough to generate a gear tooth completely. We will refer to these conditions more in detail later on.

(To be continued in next week's issue.)

Making the Peerless Ring Gear, Spider and Gears

Methods by Which Accuracy in Boring, Turning and Grinding Are Secured—Chucks for Accurately Locating Pieces of Awkward Shape

By FRED H. COLVIN
Editor, *American Machinist*

THE ring gear for the Peerless car is made of electric furnace steel and is approximately 10⅝ in. outside diameter in the rough. The finished face is 1⅜ in. The sequence of operations is as follows:

Operation 1. Anneal.
Operation 2. Clean off scale.
Operation 3. Rough bore chamfer, face both sides of web and face back side.
Operation 4. Drill eight 31/64-in. holes.
Operation 5. Countersink both sides of holes.
Operation 6. Rough-turn and face outside.
Operation 7. Ream eight ½-in. holes.
Operation 8. Finish-turn all angles.
Operation 9. Inspection.
Operation 10. Rough-cut teeth.
Operation 11. Finish-cut teeth.
Operation 12. Chamfer teeth.
Operation 13. Remove all burrs.
Operation 14. Lap with pinion.
Operation 15. Inspect before hardening.
Operation 16. Heat-treat.
Operation 17. Inspect for hardness.
Operation 18. Grind, bore and face.
Operation 19. Inspection and pairing.

After annealing and sandblasting to clean off the scale, Operation 3 is performed on a 12 x 6-in. Hartness automatic lathe. The total tool set-up is shown as well as possible in Fig. 1, although the compactness of the machine makes it difficult to photograph the tools in place.

The drilling operation is performed by the multiple drilling head shown in Fig. 2, mounted on a Barnes drilling machine. The form of fixtures used can be readily seen. The face of the gear fits over the ring at *A* while the plate *B* drops into the center hole and locates the position of the drill bushing with reference to the finished surfaces of the gear. The gear itself is shown at *C*. The double fixture allows a second gear to be put in place during the drilling of the first and the table is swung from one position to the next without loss of time. The fixture is a simple but effective one for work of this kind.

Turning the Face

The rough-turning of the face and outside is done on a Fay automatic lathe as shown in Fig. 3. An interesting feature is the way in which the gear is held during this operation. The gear is positioned by means of dowel pins, one of which is shown at *A*. Then the plate *B*, which covers about half of the inner flange is slipped over the triangular head *C* of the draw-in bolt that forces the plate *B* into contact with the gear and holds it firmly in position during the turning operation.

The finish turning of the gear is done on a Lodge & Shipley lathe, as shown in Fig. 4, where the arrangement of the tools for turning both the face and the outside bevel can be seen. The gear blank is positioned by the hole in the center and the two studs *A* and *B*, which help to drive it. The clamp *C* fits the inner flange. For quick action this clamp has a hole through the center large enough to slip over the nut and washer on the central stud. The swinging clamp *D* is then put in position under the washer and in this way the gear can be quickly handled both in and out of the lathe. The two compound rests are set to give the proper angles and the job is finished quickly and accurately on this machine.

The chamfering of the outer ends of the teeth is accomplished in a special fixture mounted on a Whitney hand milling machine, Fig. 5. This fixture holds the gear at the proper angle and it will be noted that the

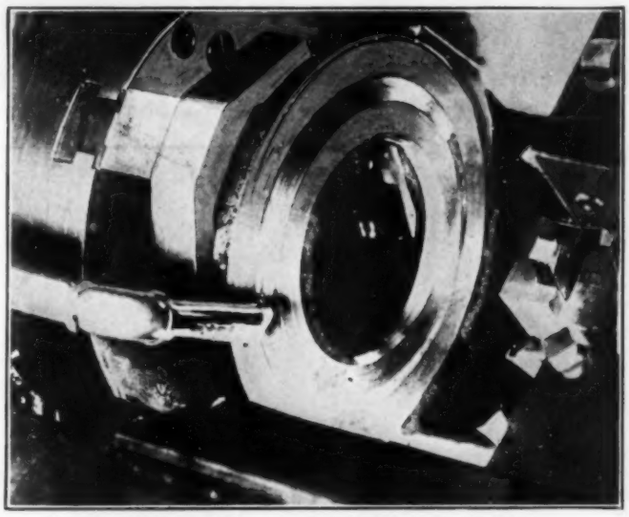


FIG. 1. ROUGH-TURNING AND BORING

method of clamping is identical with that used in Fig. 4. It will also be seen that there are two indexing pins at *A* and *B*.

After this operation comes the burring, lapping, inspection and heat-treatment, as can be seen from the list of operations.

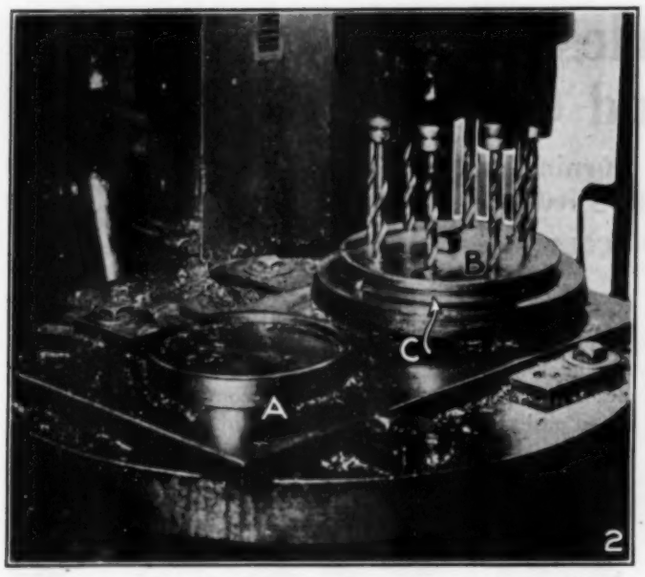
The differential pinion is turned from bar stock and is a screw-machine job except for the drilling, grinding and gear cutting. The tooling, which is a double-forming-tool job, is shown in Fig. 6. The end of the bar is supported by a center in the turret while the two cross-slide tools form and cut off the piece.

The Differential Spider

The differential spider which carries the four small beveled gears is a drop forging in the form of a cross with a large hub in the center. While the machining operations are comparatively simple it is nevertheless something of a problem to have the four arms 90 deg. apart and in the same plane, within high-grade commercial limits. The operations are:

Operation 1. Bore, face and chamfer both sides and turn ends.
Operation 2. Turn legs.
Operation 3. Drill hole.
Operation 4. Mill oil grooves in legs.
Operation 5. Heat-treat.
Operation 6. Grind hole.
Operation 7. Grind legs.
Operation 8. Inspect.

The first operation is performed on a Potter & Johnston machine and is shown in Fig. 7. The spider is held in a special fixture mounted in a three-jawed chuck, the raised part of the fixture holding the spider



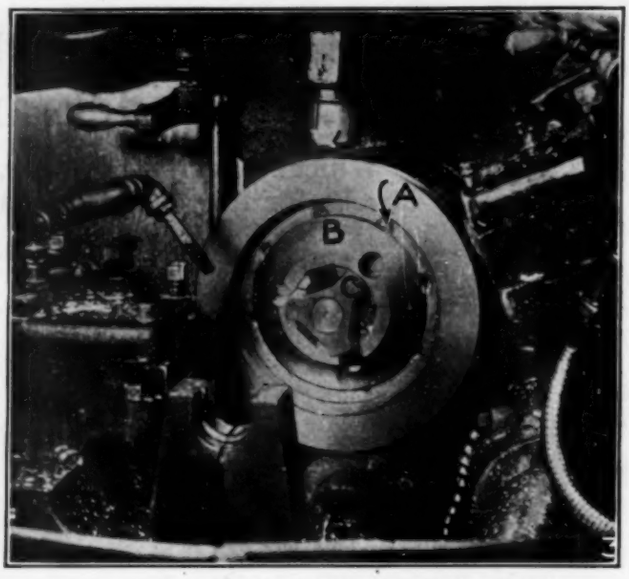
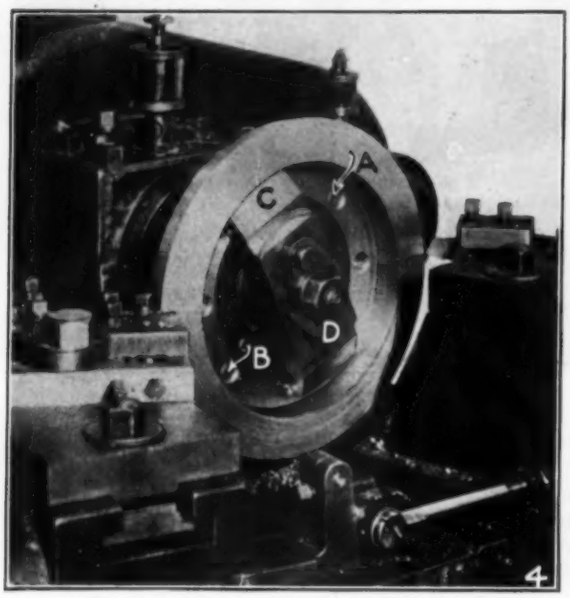


FIG. 2. DRILLING EIGHT HOLES IN DOUBLE FIXTURE. FIG. 3. ROUGH-TURNING OUTSIDE AND FACING



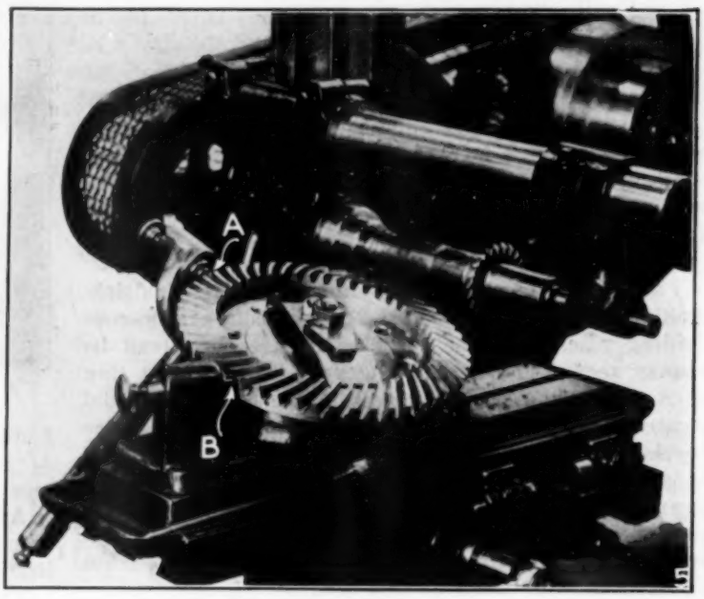
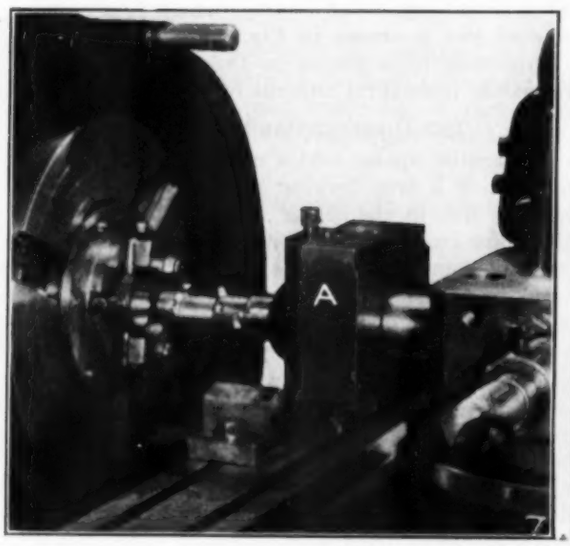


FIG. 4. FINISH TURNING. FIG. 5. CHAMFERING HELICAL TEETH



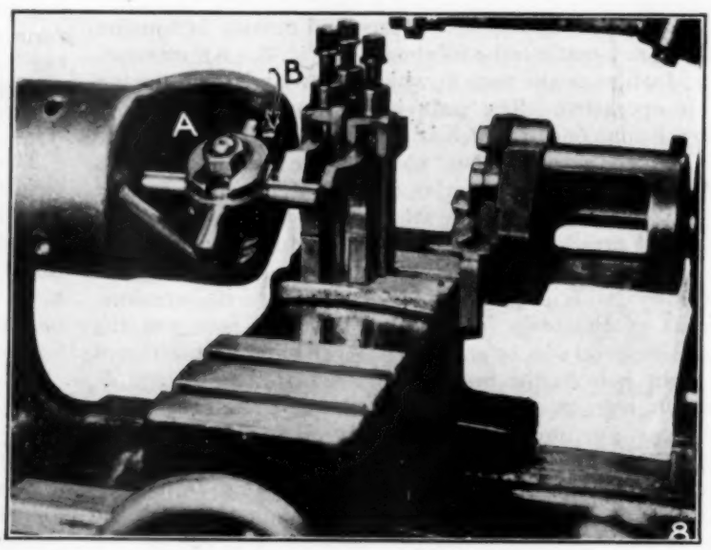


FIG. 7. BORING THE SPIDER HUB. FIG. 8. TURNING THE SPIDER ARMS

so that the hole will be bored square with the arms. The boring bar has inserted cutters and is mounted in an adjustable head *A*. The hole is first drilled and

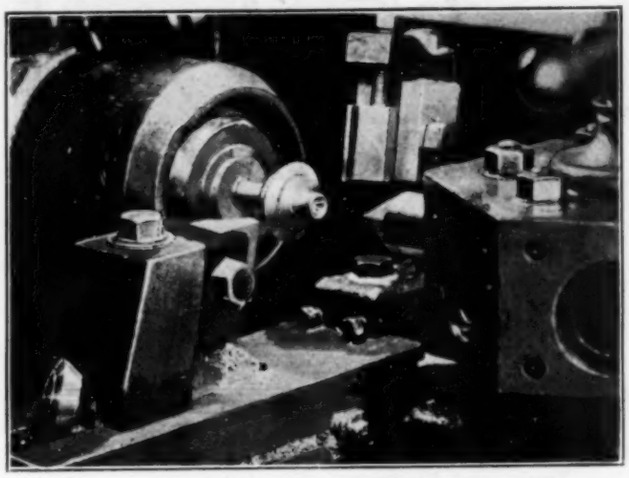


FIG. 6. TURNING THE DIFFERENTIAL GEAR

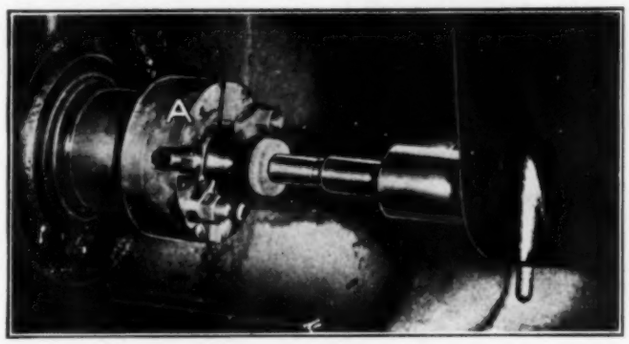


FIG. 9. GRINDING THE CENTRAL HOLE

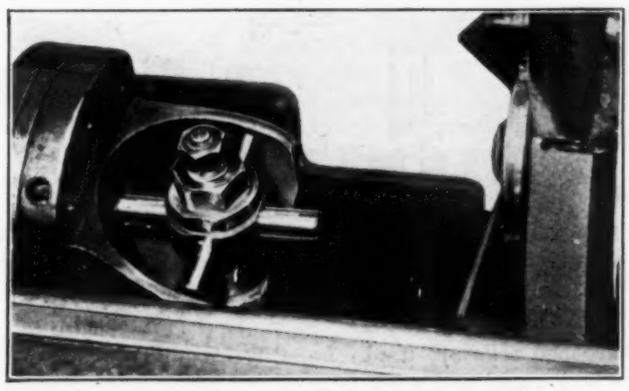


FIG. 10. GRINDING THE SPIDER ARMS

afterward bored to the grinding limit by the bar shown. Both sides of the hub are faced by the double set of cutters shown. The turret is run in to its proper position which is determined by a suitable stop and the facing cutters then fed out by means of the sliding head shown at *A*, facing both sides of the hub at once.

Next comes turning the four arms of the spider. This operation is done in a Warner & Swasey turret lathe with the spider held as at *A* and the position located by means of the stop *B* as in Fig. 8. This method of locating makes it easy to position the spider when turning the different legs. The tools shown in the toolpost face the shoulders and chamfer the ends.

After milling and heat-treating, the hole in the spider is then ground, being held in the fixture shown at *A*, Fig. 9, which locates it by its four arms. The hole is then ground by the wheel shown, the machine used being a Bryant internal grinding machine.

In grinding the arms which comes next, a fixture, Fig. 9, somewhat similar to that shown in Fig. 2 is used. This fixture allows the four legs to be indexed to their proper positions for final grinding. Close inspection of the arms will show the grooves which have been previously milled to assist in lubricating the pinions when in use.

Motor Troubles and Repair

By R. Cowan

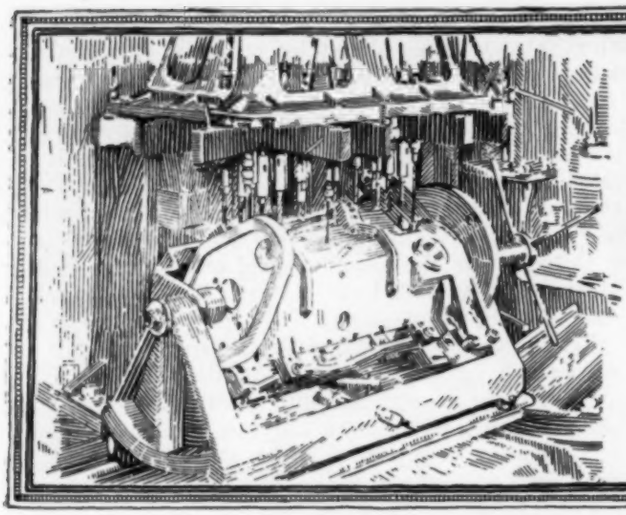
It looks as though I. B. Rich is leaving quite a job for the real mechanic, and while some of the real machine repair shops are going to considerable expense for equipment, there are still quite a few things that require careful personal study. Among these are piston clearance, which seems to be as hard to arrive at as it is to maintain; also carbon on the inside of *one* piston when three more in the same block have none, which lets out both the designer and the oil. Some cases can be cured with correctly fitted pistons and rings and others cannot, which seems to indicate that the water circulation is poor around this cylinder.

One quite noticeable change in design has come with the present vacuum system and some such arrangement as the Holly vaporizer, as used on the Fordson tractor, would seem to be much better than the present attempt to heat the whole volume of gas.

While three and four-ring pistons are common, one automobile rebuilt into a truck is giving good service with only one ring.

I don't understand how they are made but I am sure a good mechanic would hate to use some of the pistons sent out for replacement as the ring grooves are out of true with the skirt as much as 0.01 in. With such pistons it is plain to see why Mr. Rich's friend prefers narrow rings.

Grinding cylinders with a hot wheel is something we try to avoid. Data on results would be interesting and while it would take more time the results may warrant it.



Tool Engineering

By
Albert A. Dowd and Frank W. Curtis
President and Chief Engineer
Albert A. Dowd Engineering Co., New York City

Design of Riveting Fixtures—Riveting Machines—Types of Rivets—Locating and Clamping—Use of Tables—Ring-Staking Tools and Fixtures—Ejectors

THE process of riveting is used extensively in many classes of work, both small and large. For example, adding machines, typewriters, cash registers, etc., have many small parts made up from two or more units, assembled and riveted together to make a single component of the mechanism. Automobile frames, steel girders for buildings, ship plates, bridges and many other forms of structural work depend largely on the process of riveting to locate and hold together the various structural members. Rivets in structural work are usually heated before driving but for small parts cold rivets are used and it is here that riveting fixtures are used to advantage.

Rivets are headed over either by hand or machine. In some cases the rivets are in such a position that it is very difficult to head them over on a machine, necessitating a hand operation. Hand riveting as a rule does not require a fixture.

The machines used for riveting are of two general types, one of which heads the rivet by spinning the metal over to form a head; the other peins the metal by striking successive blows. Both types are extensively used, the selection being dependent upon the kind of work that is to be done.

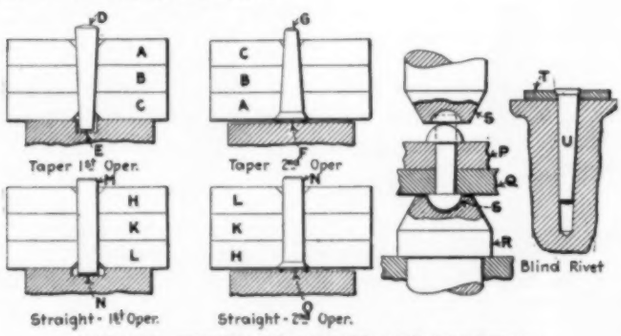


FIG. 199. TYPES OF RIVETS AND RIVETING

Riveting machines are made in several styles, both horizontal and vertical; single, double and multiple spindle; operated mechanically or by pneumatic power. In some machines work is placed on an anvil and the spindle is moved up to it; in others the anvil itself moves toward the spindle. In the reciprocating type of machine the spindle is arranged to hold a pein of suitable form, while in the rivet spinning machine

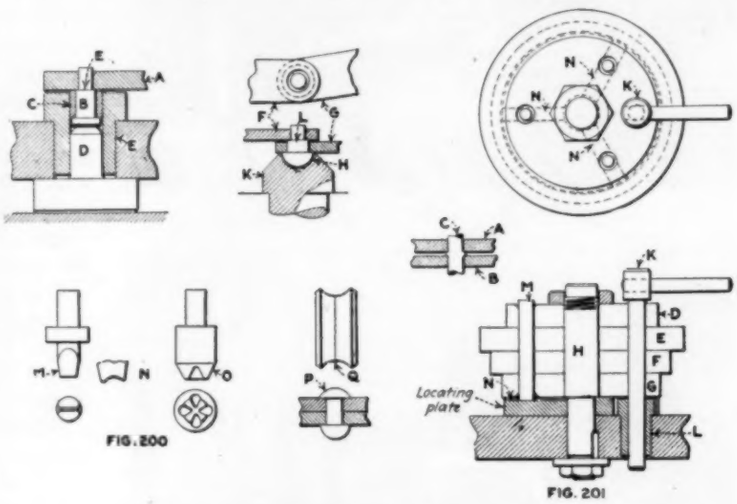


FIG. 200. FORMS OF RIVETING TOOLS. FIG. 201. LOCATING AND CLAMPING FOR RIVETING

hardened rolls are used. In either machine the action is very rapid and work is produced much more quickly than by hand riveting.

Machine riveting produces sharp, quick blows which are rendered elastic by springs or rubber cushions. In the pneumatic type the air acts as a cushion. The force of the blow can be regulated by the operator. The application of riveting fixtures covers such a wide field that it will be understood better by referring to the various examples given in this article. The facility with which work can be handled generally governs the production, as the actual time consumed by the riveting operation is very small.

The kind of work to be riveted affects the shape and form of rivets used. Straight rivets with round heads are often used when the appearance is important and when there is plenty of room in the mechanism so that projecting rivet heads will not interfere with some other

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part. Straight rivets with flat or countersunk heads are also much used for plain work. Taper rivets are valuable when correct relation of several parts to each other is required.

Fig. 199 shows several types of rivets and methods

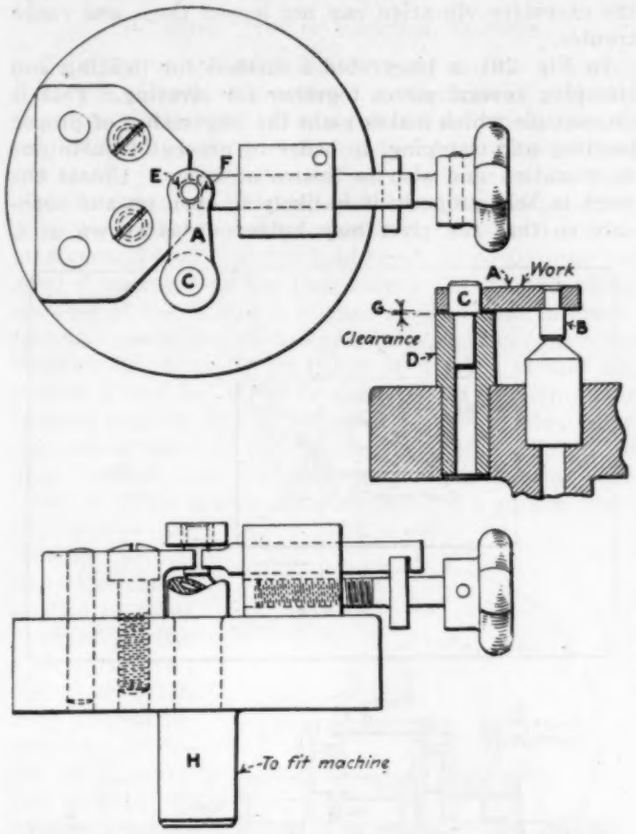


FIG. 202. RIVETING FIXTURE SHOWING METHODS OF LOCATING AND CLAMPING

of riveting. Pieces *A*, *B* and *C* are to be riveted together with taper rivets as shown at *D*. Before the riveting operation the parts are reamed in a locating jig and rivets are insertel to act as dowels and keep the parts together. The form of locating jig mentioned has been described under the head of drill jig design.

In riveting these parts together a taper rivet *D* is used. The first operation heads over the large end of the rivet and it is important that clearance should be provided in the riveting fixture at *E* so that the rivet will not bottom. After the large end has been headed the work is turned over so that the small end comes uppermost as at G. The other head of the rivet rests on the anvil at F. Care must be taken to see that work does not rest on the block in this case as the rivet head might be somewhat lower than the surface of the work which would allow it to be forced out during the riveting process. This would cause a loose fitting rivet and inaccurate work. It is important that taper rivets should be made of uniform length and the holes must always be carefully reamed.

Straight Riveting

When straight rivets are used in fastening several pieces together as shown at *H*, *K* and *L*, the anvil used must be cut away to allow the end of the rivet to seat itself as shown at *N*. The depth of the recess should be sufficient to allow for a head on this end of the rivet when the work is turned over. After the head *M* has been formed the work is reversed and the head takes the position *O*. The other end *N* can then be riveted taking care that the head *O* rests firmly on the anvil.

Round Head Rivets

This is the most common type of riveting, as the rivet is always provided with one head. This head rests in a special anvil *R* which is cupped at *S* deeper than the rivet head and slightly smaller in diameter. This supports the rivet and also prevents it from turning. Riveting of this kind is often done on a punch press as well as a riveting machine and several rivets may be headed at the same time, providing the work is uniform.

Blind Rivets

When rivets do not go through the piece of work they are called blind rivets and are generally made in taper form as shown at *U*. When a case of this kind is found, the taper of the hole should be slightly different from that of the rivet in order that a wedging action will be produced due to the difference between the two tapers. This wedging action is sufficient to hold the rivet in place.

Method of Riveting Rollers

If a roller such as that shown at *C* in Fig. 200 is to be held in place in a piece of work *A* by means of the special rivet *B*, provision must be made so that the roller will be free to move on the rivet. Suitable allowance must be made so that the shoulder *E* is slightly longer than the roller. When the rivet is headed on the upper end there will be sufficient clearance to allow the rolls to revolve. In setting up work of this kind a

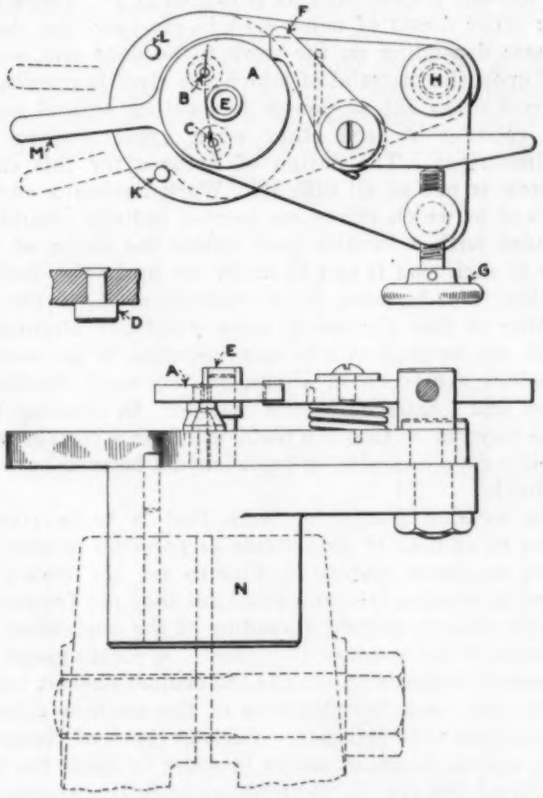


FIG. 203. SWINGING TYPE RIVETING FIXTURE FOR TWO HOLES

special anvil can be made as at *D*. This anvil is smaller than the rivet head in order to prevent upsetting the head. The bushing *E* serves to locate the rivet and roll.

The method of riveting a hinge is shown at *F* and *G*. The anvil K is made so that it will hold the round head

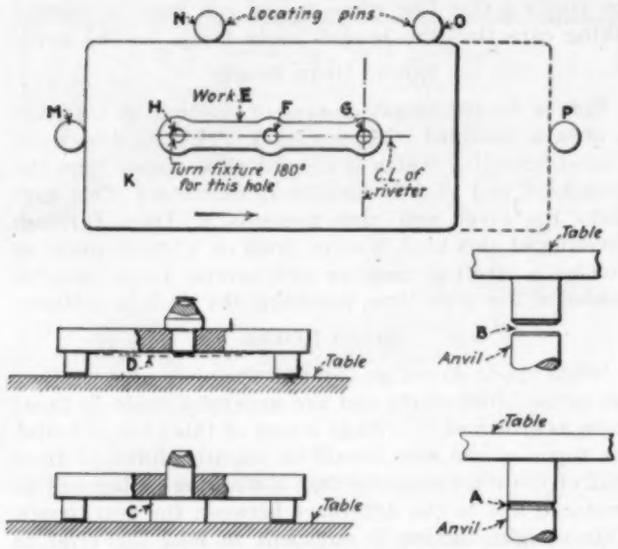


FIG. 204. USE OF SPECIAL TABLE WITH LOCATING PINS

rivet *H*. A shoulder is provided at *L* which gives the proper allowance between the two parts. The operation of riveting can be done in the regular way.

Several forms of peins are shown at *M*, *N*, *O* and *Q*. The form *M* is used for flat and countersunk rivets. *N* is somewhat similar but being cupped slightly has a greater spreading action on the rivet. The form *O* has a series of points which tend to pein the rivet rapidly. In the rivet spinning machine a hardened roll *Q* is used to form a rivet head as indicated at *P*. There are many other forms of peins used in riveting, the shape of these depending on the work to be done and somewhat upon the material of which the rivet is composed.

Rivets often act as dowels in locating several parts with relation to each other when great accuracy is not important. The design of fixtures for this class of work is not at all difficult. Work having a center hole and in which rivets are located radially should be provided with a location hole unless the shape of the piece is such that it can be easily set up in the desired position. For instance, if two washers are to be riveted together so that the center holes will be in alignment, a stud can be used as a locater; whereas if the outside diameters are to be in alignment the work should be nested and located from the outside. In riveting two gears together so that the teeth will bear a certain relation to each other, pins or pawls should be used between the teeth.

The location points for work that is to be riveted should be as near to the outside as possible, in order to obtain maximum accuracy. Clamps are not always required in riveting work together but they are frequently used in order to prevent spreading of the work when the pressure of the hammer is applied. A rivet spread out between two pieces of work is the ordinary result unless clamps are used, the vibration of the machine causing the two pieces to separate. Various types of rivets require special forms of anvils in order to avoid the possibility of bad rivets. Several points in this connection have been brought out in Figs. 199 and 200.

The position and location of the fixture on the riveting table must be so arranged that the rivet will be directly over the anvil and in contact with it. The production required on any riveting proposition does not necessarily affect the design of the fixture as there are not many ways of riveting work. Positive and rapid clamping are important however, and the accuracy of the product is dependent upon the location and the use of proper rivets.

Vibration should always be considered. All loose parts of fixtures should be well screwed down so that the excessive vibration can not loosen them and cause trouble.

In Fig. 201 is illustrated a method for locating and clamping several pieces together for riveting. This is an example which makes plain the importance of proper locating and clamping, in order to prevent trouble due to vibration and also to insure accuracy. Unless the work is held properly it is likely to open up and separate so that the rivet may bulge out as shown at *C*

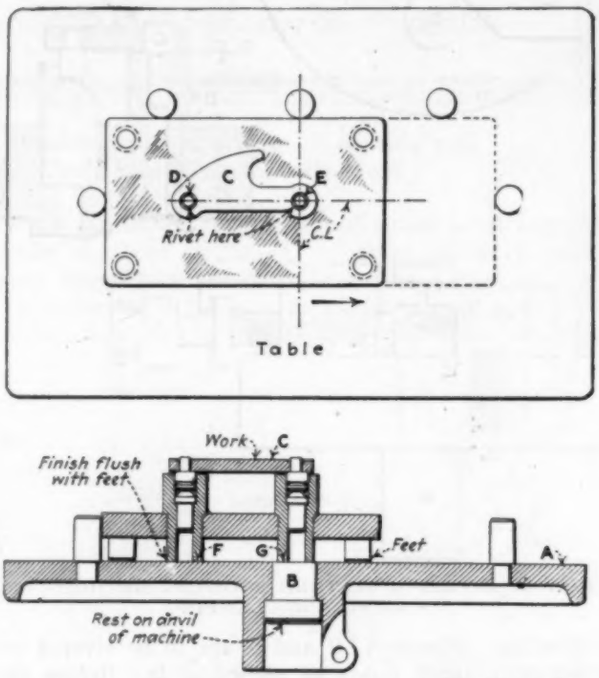


FIG. 205. EXAMPLE OF RIVETING FIXTURE USING SPECIAL TABLE

between the plates *A* and *B*. Rivets should not be used as dowels to locate work if great accuracy is required; other means should be provided. In the example shown the four pieces *D*, *E*, *F* and *G* are slipped over the center stud *H* and clamped by means of the nut shown. The locating plug *K* is a loose piece which is pushed through all the pieces and into the bushing *L* which locates it. This is better than a station locating stud similar to the center one, because it is less likely to be sprung out of its true position. The locating plate is slotted in three places to allow for the rivets *N*. For riveting the other side of the work another fixture is necessary.

Method of Locating and Clamping

The type of fixture shown in Fig. 202 is very good for a number of kinds of work and it can easily be standardized. In the example given, the work *A* is to be furnished with a pin B which is to be riveted in place. The center distance from *C* to *B* is very important. The work is located on the stud *C* and the riveting is done over the anvil shown. The anvil is directly over the portion *H* which fits the riveting machine. The work is nested between the fixed member E and the movable pin *F*, the latter being arranged so that it does not turn as it is moved by the screw. This clamping arrangement has been previously described.

Attention is called to the location of the pin C in the bushing *D*. This provides for easy replacement of the pin when worn and thus preserves the accuracy. Clearance should be allowed at *G* so that the work will not rest on anything except the rivet.

Swinging Type of Riveting Fixture

To assist in the rapid handling of work a swinging fixture is often an advantage. An example of this kind is shown in Fig. 203. The work *A* has two rivet studs as indicated at *D*, these being located at *B* and *C* as indicated. As they operate in a face cam in the completed mechanism their location is important and they must be firmly riveted into position. The work locates on a central stud *E* and is held firmly in position by the pawl *F* operated by the thumbscrew *G*. The swinging member of the fixture is pivoted at *H* so that in operation the rivets can be brought into position under the hammer by swinging the lever *M* until it strikes the pins at *K* and *L*. When in the riveting position ample support is given by the fixture at *N*, this portion being clamped in place in the riveting machine. The dotted lines indicate the two positions of the fixture when riveting. This is a clean cut example of a simple riveting fixture involving principles which can be applied to other work of similar character. Tables are often used on riveting machines in order to simplify the location of fixtures which are to be used for several operations. Also when fixtures are large and when rivets are so spaced that they cannot easily be located on an anvil, a table permits easy location and makes the operation of riveting more convenient. A few points in connection with the use of tables are illustrated in Fig. 204. It is important that the table should be so located that the stem *A* will be in positive contact with the anvil on the machine. There must never be a space between them as indicated at *B* as this would not give proper support. The fixture which may have an anvil of its own, must also always be made so that the under side of the anvil is in contact as at *C*. It should never be made as shown at *D* as this would not give good results and would buckle as indicated by the dotted line.

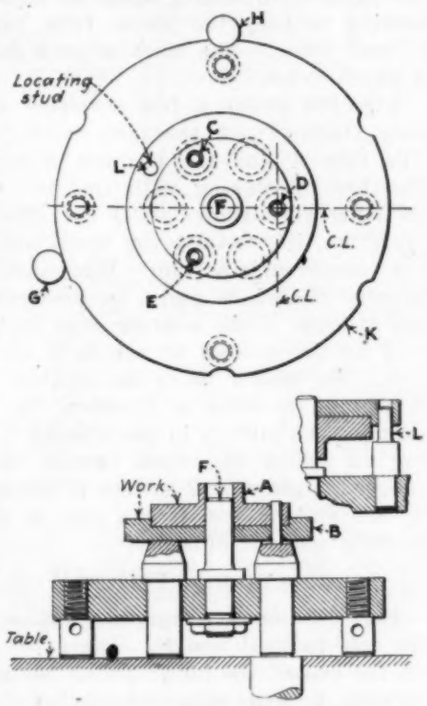


FIG. 206. RIVETING FIXTURE FOR BOTH SIDES

In locating any fixture on the table an arrangement of pins can be provided so that several locations can be easily made. If a number of pieces of a similar kind are to be riveted it is often possible to standardize the tables and the relation of the pins so that fixtures can be built which will all be usable on the same table. The work *E* for example is to be riveted at *F*, *G* and *H* and it is located for the operation on the riveting fixture *K*. Locating pins are provided at *M*, *N*, *O* and *P* so that by moving the fixture along as indicated by the dotted lines, all three rivets can be brought into position over the center line of the riveting machine. Other fixtures for work of similar shape and size can be so made that the same table can be used in each case.

In Fig. 205 is shown another example of a fixture used on a special table *A*. The plug *B* must rest on the anvil of the riveting machine. The work *C* is to have the two pins *D* and *E* riveted in place and the method of location here is the same as that previously described. The ends of the bushings at *F* and *G* must be ground so that they are flush with the feet of the fixture in order that they will be in contact with the plug *B* during the riveting operation. The locating pins on this table are arranged in similar fashion to those previously described.

Riveting Fixture Used for Both Sides of Work

The designing department can often help in simplifying the design of riveting fixtures by paying attention to the location of rivet holes, and placing them in such positions that the same fixture can be used for riveting both sides of the work. An example which illustrates the advantages of this forethought is shown in Fig. 206. The pieces *A* and *B* are riveted together at three points *C*, *D* and *E*, these points being 120 deg. apart and the same distance from the center. The pieces are assembled on the center plug at *F*, resting on six plugs as indicated. Three of these plugs are cut away to allow for the heads of the rivets, while the other three are plain on the top. For the first riveting operation the slotted pins are used successively; but for the second the plain pins are used, the work being turned over.

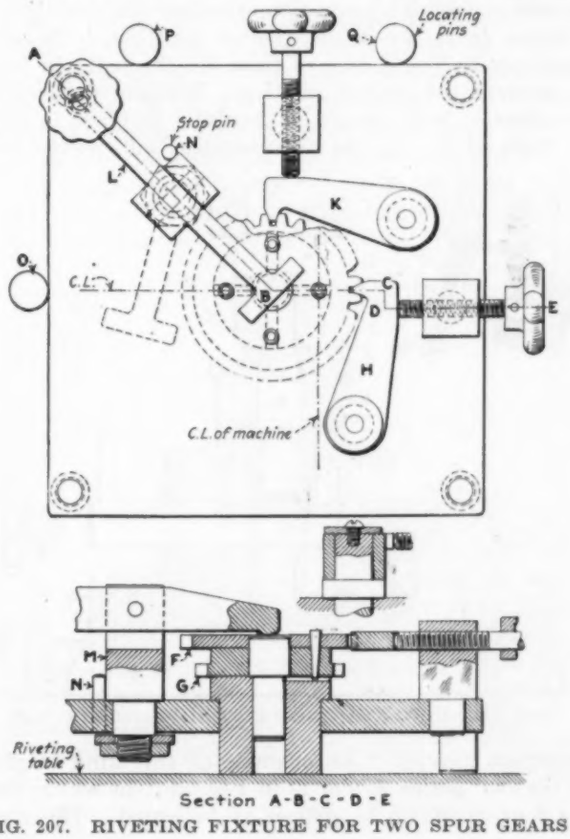


FIG. 207. RIVETING FIXTURE FOR TWO SPUR GEARS

Two pins *G* and *H* are used in the riveting machine table to act as locaters for the fixture. It will be noted that the edge of the fixture is notched in several positions so as to give correct locations for the various rivets. The notch acts as one locater against the pin *H*, while the other location is fixed by a contact of the

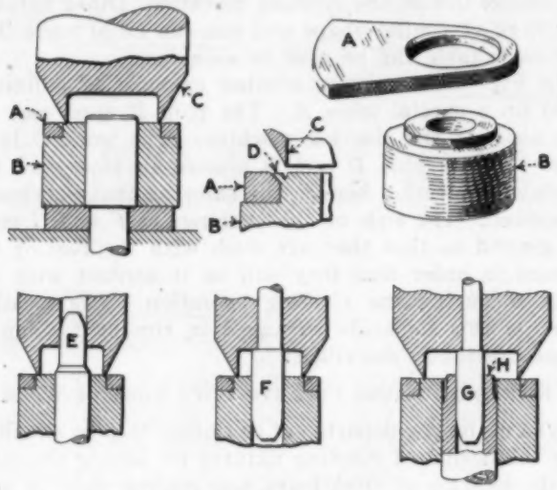


FIG. 208. EXAMPLE OF RING-STAKING AND TYPES OF RING-STAKING TOOLS

outside of the fixture with the pin *G*. A pin *L* is placed in the fixture to locate the two pieces and attention is called to the manner in which it is cut away so that it will not interfere with the flange indicated. All of the six studs used for riveting are flush with the legs of the fixture thus assuring proper support when they are brought into position for riveting. This fixture is built high in order to make it easier to turn over; it is dirt proof and easy to clean. The design being so made that both operations can be done in the same fixture cheapens the cost considerably and also expedites the operation.

When gears are to be riveted together it is often necessary to locate each of them by the teeth in order to preserve the correct relation. Riveting fixtures for this class of work should be carefully designed in order to make sure that no inaccuracies will result from

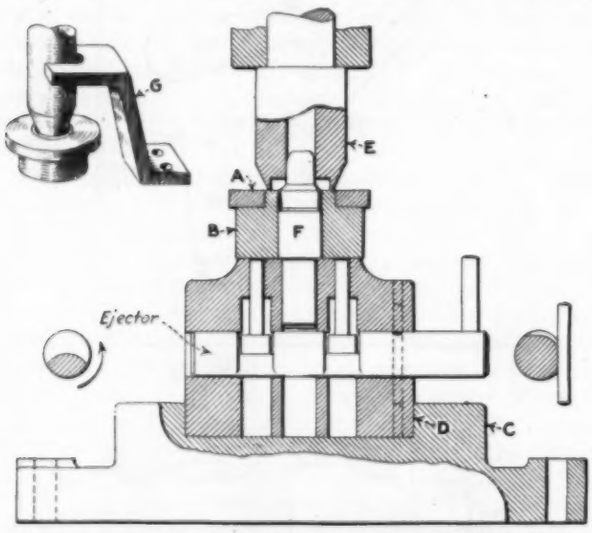


FIG. 209. RING-STAKING FIXTURE WITH EJECTOR

imperfect location. An example of this kind is given in the two pieces *F* and *G* in Fig. 207, in which there are four rivets to be driven as indicated. The rivets used are tapered, therefore provision must be made to prevent the small end of the rivet from bottoming in the slot during the first riveting operation. The work is located on a central stud and the pawl *H* engages with a tooth in the part *F*; the pawl *K* is used similarly with the gear *G*.

A swinging clamp of special design is used to hold the work as indicated at *L*. This clamp swings on a stud *M* into the position shown by the dotted line so that the work can be easily removed. The stop pin *N* limits the movement. The riveting table has three pins *O*, *P* and *Q*, which serve to locate the riveting fixture in the manner previously described. For certain classes of work fixtures of this kind are very much used and by using a standard plate a number of fixtures can be handled on the same table without difficulty.

Ring Staking Operations

Ring staking is the process of peining over or swaging two pieces of work together by means of a circular tool having a sharp edge which swages or forces the metal on one piece of work over into a countersunk portion on the other. A ring staking operation is often used when work is to be riveted, as it prevents the parts from coming apart or separating, the rivets serving to keep the pieces from turning in relation to each other. The machine used for ring staking is a punch press.

Fig. 208 shows a few examples of work requiring ring staking, and the tools used for the operation. The cam *A* and the bushing *B* are to be fastened together by staking with the tool *C*. The enlarged sectional view shows at *D* the effect of the staking operation, the metal being upset and forced over into the countersunk portion. Ring staking tools are frequently piloted to assist in preserving accuracy. In the example *E* the locating stud in the fixture is carried up far enough to act as a pilot in the staking tool. The pilot *F* is in the staking tool itself so that it centers the work as it enters the hole. In another example the pilot *G* in the staking tool enters a bushing on which the work locates, the bushing being relieved slightly at *H* so that if the metal is contracted by the staking tool it can still be removed from the bushing without difficulty.

Ring Staking Fixture With Ejectors

Fig. 209 shows a complete fixture for ring staking the two parts *A* and *B*. The fixture fits in a shoe *C* on the bed of the punch press, being located and held in place in some approved manner. The counterbored portion of the shoe *D* can be standardized so that a number of fixtures can be used with the same shoe. The staking tool *E* fits the ram of the punch press as indicated. The work locates on a stud *F* which extends above it and acts as a pilot for the tool.

Work of this kind sometimes clings to the tool and rises with it, in which case a stripper like that shown at *G* may be found an advantage. Work may also stick on the locating plug so that it is not easily removed without using an ejector. It is advisable to provide for both contingencies by using both stripper and ejector. The form of ejector used in this instance has been previously described so that further comment is unnecessary. It is important to know the stroke of the press when designing ring staking fixtures, in order that the height of the fixtures may be kept within the required limits.

Piston Work In Motor Repairing

Finishing Semi-Finished Pistons—Fitting Piston Pins and Rings—The Importance of the Crankshaft—How To Assemble the Motor—How To Avoid Scored Cylinders

SPECIAL CORRESPONDENCE

IT IS WELL to remember that in manufacturing pistons a regrinding shop equipped with only a lathe and a drilling machine to do this work cannot hope to compete with a manufacturer who has the proper equipment and up-to-date methods. Probably the only time when it does seem advisable to make pistons complete, is for orphan sizes. Especially is this true if it is a rush job and the regrinding shop is a long way from the piston manufacturer.

Pistons should be of best gray iron, closely grained and sufficiently rigid and reinforced to stand strains and still not be too heavy for high-speed performance. It is possible to make such a piston only with a uniform wall; and to do this, the operations are as follows:

Start by holding the piston on the inside diameter while the center hole is put in the closed end and a roughing cut is taken on the outside. The opposite end can then be chamfered while holding the rough-turned piston in a chuck. By such methods uniform thickness of wall can be obtained. Another particular operation is that of drilling the wristpin hole, which must be at right-angles to the axis of the piston. This operation can be done on a drilling machine using a jig, or on a lathe. There is one operation on pistons that can be nicely taken care of by practically all regrinding concerns, and that is the finishing of the outside diameter. Most manufacturers will furnish pistons either finished or semi-finished. By using a semi-finished piston, which usually comes $\frac{1}{16}$ in. oversize, and grinding it down to fit the bore, not only will it increase production, but it will allow the covering of a larger range of sizes on the same investment.

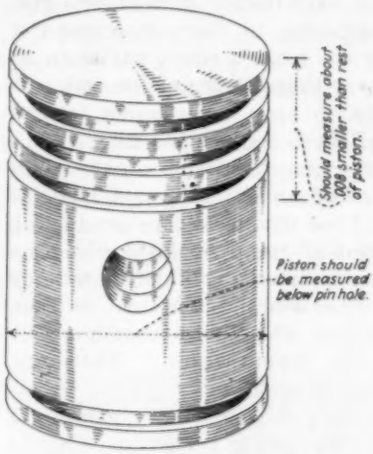


FIG. 1. MEASURING A PISTON

Finished pistons will change, even when bought from the best of manufacturers, and will frequently be found out of round. A slight tap with a wooden hammer when fitting will generally true them.

In finishing the outside of the pistons a suitable external grinding machine must be obtained. In securing such a machine, it is well to keep in mind two facts: That the length of a piston seldom exceeds 6 or 8 in. and the diameter even on the larger sizes does not ordinarily run over 5 in. Therefore a small-size external grinding machine that will swing 6 or 8 in. with sufficient length between the centers is very satisfactory.

The pin holes on semi-finished pistons come rough-reamed with 0.002 or 0.003 in. left for finish reaming. Any good adjustable hand reamer will take care of this. In finishing the outside diameter, the lands between the rings should be relived and made smaller than the skirt by at least 0.008 or 0.010 in. The excess heat and solid metal cause greater expansion at this point.

Always measure a piston below the wristpin hole and not above it on the head, as shown in Fig. 1.

Piston Pins

While the standard pins can usually be secured from stock in 0.003, 0.005 or 0.010 in. oversize, it sometimes is necessary to order special ones. That there may be no confusion in ordering special sizes, be sure to give oversize above standard, make of car, model, motor, diameter and length, slot or setscrew hole, width and depth of slot, diameter of setscrew hole, distance from center of setscrew hole to end of pin; also state if pin has oil holes or oil grooves. See Fig. 2.

Colors have been generally adopted by oversize piston-pin manufacturers in order to identify the pins so that they can be readily distinguished from one another. The ends are painted different colors as, standard size, no color, 0.003 in. oversize, red; 0.005 in. oversize, yellow; 0.008 in. oversize, white.

Fitting Piston Pins and Rings

Use an accurate reamer in fitting piston pins and be very careful not to remove too much metal. Remember that the clearance between the pin and bearing should be 0.0005 to 0.001 in. A loose-fitting piston pin with too much clearance will cause a piston-pin knock which will eventually mean that the whole motor will have to be pulled down and new pins inserted. On the other hand, if the pin is a wringing fit, it will cause trouble, because there must be room for a film of oil on the pin. A well-fitted pin will last for years.

In fitting rings, first try them in the piston grooves. They should be perfectly free, but without side play. If a little too wide to slip into the grooves, lay a piece of fine abrasive cloth on a flat surface and rub the ring until it just fits. The distance between the end of a gap cut ring should be from 0.0015 to 0.002 in. per one-inch diameter of the cylinder.

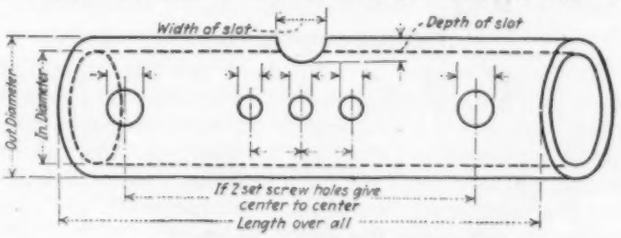


FIG. 2. PISTON-PIN DIMENSIONS

The whole secret of a good ring is that it be perfectly round when in place, and the best results will be obtained if you see that it is so.

No hard and fast rule can be given as to the amount of clearance which should be allowed between the pis-

tons and cylinder walls. There are so many conditions to be taken into consideration, including the construction and speed of the motor, style, and material of the pistons, also the parties who are to drive and the service given the motor after grinding.

Even the manufacturers themselves are divided on this point, each having his own pet theory on what it should be. Some idea of how they vary can be judged from the table of a few of the makers of cars.

As a general rule it is safe to allow 0.001 in. to each inch diameter of the hole on cast-iron pistons. The

MANUFACTURERS' CLEARANCES

Maker	Finish	Diam.	Clearance	Piston Material
Chalmers	Grind	3½"	0.005	Lynite
Chevrolet	Ream	3.686"	0.003	C.I.
Continental	Grind	3½"	0.001	C.I.
Continental	Grind	3½"	0.002	C.I.
Continental	Grind	3½"	0.002	C.I.
Continental	Grind	4½"	0.002	C.I.
Continental	Grind	4½"	.....	C.I.
Dodge	Ream	3¾"	0.003	C.I.
Franklin	Grind	3½"	Taper from 0.003–0.001	Magnalite
Hudson	Grind	3½"	0.0035	C.I.
Hupmobile	Grind	3.248	0.001	C.I.
Kelly-Sp'field	Grind	3.7460	0.003	C.I.
		4.4970	0.003	C.I.
Locomobile	Grind	4½"	0.015	C.I.
			0.003	
Lycoming	Grind	3½"	0.004	C.I.
			0.0065	
Maxwell	Grind	3.622 plus	0.013	C.I.
Mitchell	Grind	3½"	0.0025	C.I.
Oakland	Ream	2⅞"	0.005	Alum.
Oldsmobile	Ream	2⅞"	0.004	Lynite
Packard	Grind	2.998	0.002	C.I.
Pierce	Grind	4½"	0.002	C.I.
			0.003	

majority of the regrinding concerns and, as can be seen from the table, the manufacturers themselves, shade the above clearance a little. This can be done, provided the fitting of the piston rings and pins is an A-1 job, and that when assembling the motor every precaution is taken in regard to squaring up the pistons and rods, giving the motor plenty of oil. It is equally necessary that the driver operate the car at moderate speed the first few hundred miles.

If, however, the motor is in a taxicab, race car, or a motor truck, it is well to be generous on this allowance and make it from 0.00125 to 0.0015 in. per inch. The heavy duty of the last two classes causes greater heat expansion than in the ordinary motor. With a taxicab, there is no assurance as to who is to drive it, and therefore it is well to take no chances. Piston manufacturers in many cases, especially on patented construction or alloy material, can best tell what clearance should be left for their particular styles of pistons.

Crankshaft Grinding

Too much cannot be said about the importance of keeping a crankshaft in perfect condition. The crankshaft, virtually the backbone of the motor, when sprung out of alignment or when its journals are worn out of round, will soon wear the main bearings and connecting-rod bearings which bear directly on the shaft, and consequently will cause the motor to knock.

It is impossible to properly fit a set of bearings to a shaft which is out of round or out of alignment, and the extra time consumed in obtaining even a fair job would more than pay for the regrinding of the shaft.

There has, however, been a great deal of misunderstanding regarding actual crankshaft grinding.

By the old method of filing, lapping, and polishing a shaft, a slow and expensive operation, which is often misconstrued as grinding, it is impossible to obtain accurate results. This work should be done on machines built especially for crankshaft grinding.

Many a perfect regrinding job has been spoiled when the motor is being assembled. If you are in a position to take down and reassemble, then you are more fortunate than many who must trust this final and very important part of the job to someone else.

Great care should be taken to first wash the cylinders, pistons, rings, etc., carefully with gasoline. Be sure every particle of abrasive material and foreign matter is removed.

Make certain the wristpin fits both the rod and piston, and see that it is securely fastened on. Better go over this an extra time and make sure, for a loose pin or screw will ruin the entire job the first time the engine is run. Measure the pistons for roundness after assembling with the connecting rods, to see they have not gone out of shape. A slight tap with a wooden hammer will usually correct any change.

After assembling the pistons on the crankshaft, test them to see if they are absolutely square. Do not take it for granted, because the connecting rods were straight before the motor was pulled down, that they will be straight when you assemble them. There are many chances and reasons why they may have become twisted or out of square. This could happen in taking off the block with the pistons still connected to the crankshaft, when it is an easy matter to bend or twist the rods. Again, in scraping in the connecting-rod bearing or in tightening the caps, a slight variation at this end will increase many times at the piston end.

It is highly important to have the pistons square. If they are not, the cylinders might just as well not have been ground, for the pistons hitting on the sides will give all the troubles of an out of round hole.

Put plenty of oil on all the pistons before assembling in the cylinder. The rest of the assembling is purely a repair-shop job, but every detail should be thoroughly gone into as though it were a brand-new car. In fact, the vital parts are new and with limits usually closer than those allowed by the manufacturer. Therefore, they should demand careful attention.

Be sure the crankcase is well filled with a good light or medium oil and that the oiling system is working perfectly. Run the motor slowly for one-half day, giving it time to cool naturally.

A scored cylinder is caused by one of two reasons. Most pistons are fastened to the connecting rods by means of a piston pin securely anchored to the piston or to the connecting rod. A special-shaped setscrew is used to keep the piston pin from moving. The thousands of little shocks due to the up and down movement of the connecting rods loosen these setscrews which hold the piston pin from moving. The movement of these loosened pins from side to side causes the walls to be scored where the pin touches.

Some pistons are equipped with brass bushings in which the piston pin works. Occasionally these bushings work loose, due to vibration, and score the cylinder walls in the same manner that the piston pin does. In fitting pins, be sure they are locked in tight, as a little carelessness here will ruin the best of regrinding jobs.

Keep a record of every job, including make and model and sizes of parts used. This is not only useful for personal reference, but in renewing pistons, rings, or pins this information is invaluable to the owner. He will appreciate your being able to give him immediate service on duplicate parts if he requires them.

Manufacturing with Special Machines vs. Standard Equipment

V. Lapping the Cylinders — Testing and Assembling—A Completed Recuperator—Comparison of Machining Times at the Otis Works and Watertown Arsenal

By COL. G. F. JENKS* and M. H. CHRISTOPHERSON†

OPERATION 47 consisted of drilling the port holes connecting the filling valve with the recuperator cylinder and is shown in Fig. 43. Three air drill holding fixtures were used and the average time of this operation on 280 sleighs was 7 hours.

Operations 41 and 47 were combined in a single operation at the Arsenal and the time given as 13.37 hours.

Fig. 44 shows lapping the finish reamed recuperator and recoil cylinders in operation 48.

Seven horizontal lapping machines were designed and made for this operation. Five of these machines had a reciprocating motion speed of 25 ft. per minute with a slight rotary movement on the forward stroke, the return stroke being parallel to the bore. Two machines were of the rotary type, rotating at a peripheral speed of the lapping shoes of about 850 ft. per minute and a longitudinal feed of 25 ft. per minute.

Two additional reciprocating motion machines were fitted up for temporary use by utilizing type 5 machines. In each of these machines the sleigh was laid on the holding fixtures and a lapping bar was fitted into the head which received its reciprocating motion by means of connecting rods driven by a crank, the crankshaft revolutions being 29 per minute. The average time required in lapping the three cylinders in 280 sleighs was 27¼ hr. The shortest average time lapping three cylinders in 10 sleighs was 10 hr. The first lot of 40

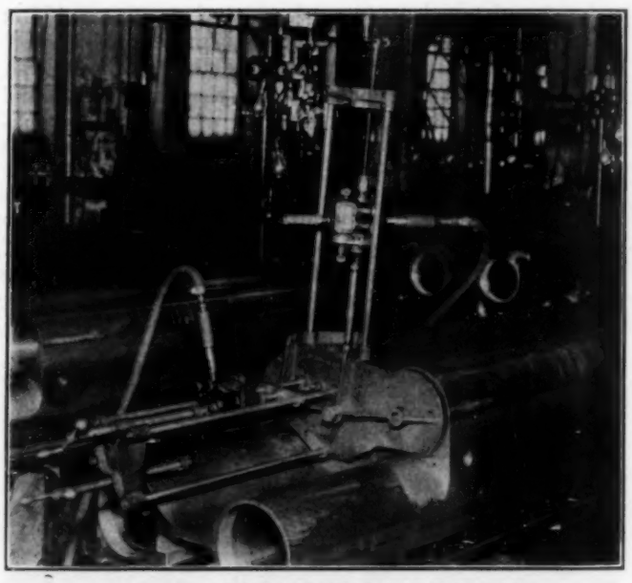


FIG. 43. DRILLING THE PORT HOLES

sleighs lapped, averaged 44¾ hr. On the second lot 240 sleighs were lapped and the average time was 24½ hr. The time at the Arsenal was 37.18 hours.

*Chief of Artillery Division, Ordnance Department, U. S. A.
†General Works Manager, Otis Elevator Co.

The bores were reamed quite smooth and true, and the question of amount of lapping required was subject to the inspectors' judgment. The recuperator cylinders were lapped until the surfaces were free from noticeable scratches, leaving a bright and hard surface for the piston packing. The recoil cylinders were lapped to a

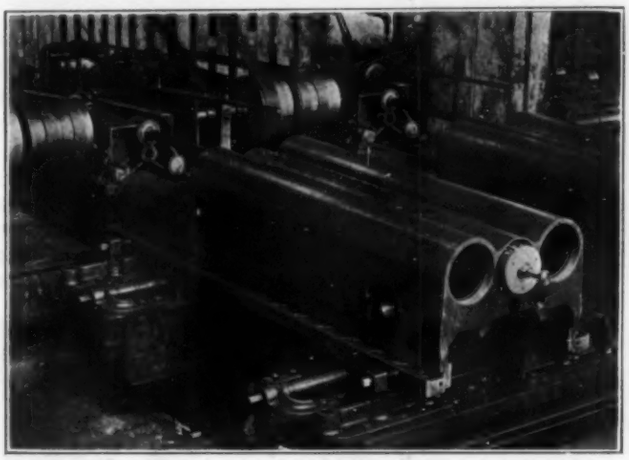


FIG. 44. LAPPING THE CYLINDERS

point of smoothness that would insure long wear of the piston liners.

After considerable experimenting with carborundum shoes and with wood blocks with various grades of grit and oil, we finally determined on the use of wood shoes with ⅜-in. felt covering. Over this was stretched No. 0 and No. 00 emery cloth. The felt provided sufficient resiliency, so springs back of the shoes were dispensed with and the pressure was adjusted by means of taper wedges. A mixture of paraffin and lard oil concentrate was injected into the cylinders with a hand pump.

Operation 49

Drilling the 3-in. circulating ports is shown in Fig. 45. Five portable drilling machines with hand feed and driven by shafts with universal joints and specially arranged countershafts were used in this operation.

Average time setting the sleigh and drilling two 1¾-in. holes, which were enlarged to 3 in. diameter with a second cutter, in 280 sleighs was 12½ hr.

Operations 35, 38 and 49 were combined in one operation at the Arsenal and the time given as 18.30 hours.

The portable machines were made on account of difficulty in securing universal radial drilling machines and they proved quite satisfactory. The spindles were set at a predetermined angle in the heads and the heads were designed to fit into the cylinder counterbores so the operator could set and bolt the drill heads without any need for careful adjustment.

Operation 50

Fig. 46 shows the application of a hydrostatic test of 4,500-lb. pressure per square inch on each of the recoil

cylinders and 2,600 lb. pressure per square inch on the recuperator cylinder and the reservoirs.

Average time required in inserting testing plugs and pipes and in making the test, 4 hr. Arsenal time, 9.78 hours.

This test was made after all operations except fitting wedges and assemblies had been completed. Three sleighs out of 280 that were tested showed slight leakage, two through the cylinder walls and one in the reservoir. Consequently they were rejected.

For convenience in making the tests and also to prevent possible error in pressure, a weighted accumulator with a plunger 1¼ in. in diameter was installed nearby and connected to the test heads with high pressure pipe and fittings. The accumulator weights were raised by means of a triplex chain block with power attachment to the handwheel.

The cylinders to be tested were first filled with raw linseed oil by means of a low pressure well pump, and the required test pressure was then applied by lowering the accumulator weights onto the plunger.

Operation 51

Milling two drain channels in the bottom of locking wedge seat along both sides of the walls in the breach and pocket is shown in Fig. 47. One portable milling device was used for this operation and the average time

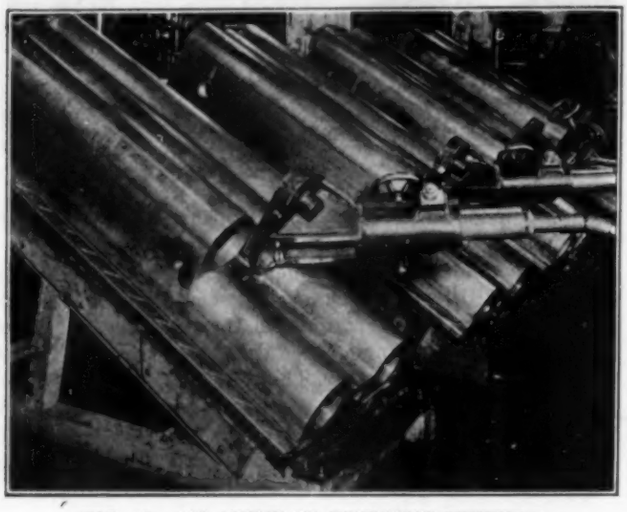


FIG. 45. AN ANGULAR DRILLING FIXTURE

on milling both channels was 1 hr. No Arsenal time for this operation is available.

The milling fixture was attached to the slide portion of the sleigh and was used for milling the right- and left-hand sides by reversing the fixture, as both ends of the driving shaft were made so an air drill, from which the power was derived, could readily be attached.

Operation 52

Consisted of whatever hand work was necessary to complete the sleigh and in fitting and assembling the locking wedges and in making final inspection.

Average time on this operation on 277 sleighs was 104 hr. Highest average time on 10 sleighs was 132 hr. lowest average time on 10 sleighs was 71 hr. Arsenal time on this operation is given at 38.28 hours.

The fitting floor occupied a space under the crane 38 ft. wide by 120 ft. long. This floor space and crane capacity would have been increased to double the size by the use of adjoining property if the need for assembly of six recuperators daily had continued, as it was the intention to continue this part of the recuperator work with one shift of men working 10 hr. daily.

Operation 53

Washing the sleigh and all component recuperator parts and thoroughly cleaning them by hand before

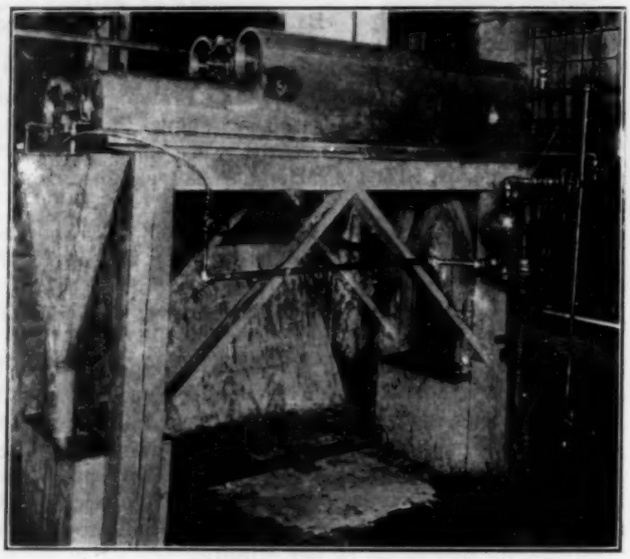


FIG 46. THE HYDROSTATIC TEST

assembly. Average time, 5½ hr. No Arsenal time given.

The sleighs and parts were washed in a solution of 2 parts regular Oakite, 1 part Oakite compound and 20 parts water, kept in a wooden tank at a boiling temperature by being circulated through coils in a gas heater.

A very servicable scrubbing machine for cleaning the reservoirs was made from a lapping head, to the end and sides of which were screwed steel prong scrubbing brushes. The head was fastened to the end of a shaft which had an air drill attached to the other end. A few revolutions of the head with cleansing compound being applied insured the removal of all foreign substance.

Operation 54

Assembling the recuperator small parts into the sleigh, filling the recoil cylinders with a solution of glycerine and water, and filling the recuperator cylinders and reservoirs with glycerine, water and caustic soda. A hydrostatic test of 3,500 lb. was then applied to the

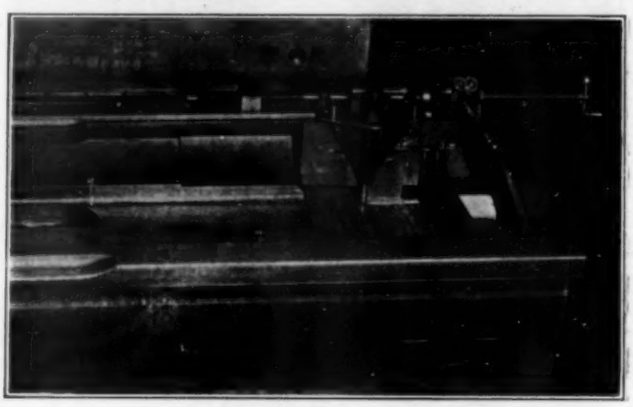


FIG. 47. MILLING OUT A CORNER

recoil cylinder to insure the piston rod packing and heads being tight.

Average time for assembly and test on 277 recuperators, 26 hr. Arsenal time, 41.08 hours.

A space 20 x 64 ft. under the crane runway was fenced in and kept clean to insure the recuperator when assembled and filled being free from any grit. As shown in Fig. 48, in this space there were three cradle fixtures in which the sleighs were held and turned to any angle required for assembly or filling. The liquid after being prepared in required proportions was distributed from Wayne filling tanks.

Fig. 49 shows the finished recuperator ready for final test. This is probably as difficult a piece to produce, and as perfectly machined, as any heavy piece of artillery equipment required for war purposes.

Operation 55

"The Gymnasticator Test" in which a gun is mounted on the recuperator or on a special stand. Average time testing 277 recuperators, 2½ hours.

In this test the recuperator was drawn back by power through long screws, a steel crosshead connecting both screws. The forward end of the crosshead has cam-operated releasing hooks which engage a corresponding hook on the sleigh. As the recuperator is drawn back the piston forces the glycerine into the reservoirs which are partly filled with glycerine and nitrogen, thus compressing the nitrogen and building up pressure so that unlatching of the releasing hooks permits the nitrogen to expand and force the recuperator back into battery position. Performance tests of the recoil cylinders, pistons and throttling rods are made by firing the howitzer at the proving grounds.

Now follows, in Fig. 50, the operations on the brake piston rods, some of the tools used being shown in Fig. 51. The rods were drilled and bored in vertical machines built for the purpose. Figs. 52 and 53 show the recuperator piston rod and the throttling rod. Fig. 54 shows the liners for the sleighs and gives all necessary details concerning them.

Brands of High-Speed Steels

The high-speed steels adopted were Red Cut—Clarite—L XX—Uranium—Firth-Sterling. For finish boring cutters and reamers, Columbia double special and Vulcan high-carbon steels were generally used. The original supply of smaller sizes of milling cutters was made by the Illinois Tool Works, Chicago, in which Uranium steel was generally used. The larger size plain and formed cutters were made in the Otis Ordnance Works toolroom, where all sizes of milling cutters were reground and replenished.

On the cutting tools a mixture of 1 part solcut to 15 parts water was used. The solution was circulated in two pumping systems, one at 5-lb. pressure for milling cutters and planer tools, and the other at 85-lb. pressure for rough boring where it was necessary to force the chips out of the bore past the drill head.

Experience as the work progressed confirmed the belief that it was most economical to reduce to a minimum the number of operations each man should perform and particularly in milling the pocket in the breech end of the sleigh, to move the work to several machines, so as to give each operator only a portion of

FIG. 48. ASSEMBLING FLOOR

the work to do, as in that way he became most proficient and his work was less subject to spoilage.

In place of planers, the use of heavy face and slab milling machines with well designed cutters and with cutting speeds and feeds definitely established showed up remarkably well by comparison.

At the commencement of the recuperator contract the productive hours of labor to fully complete all

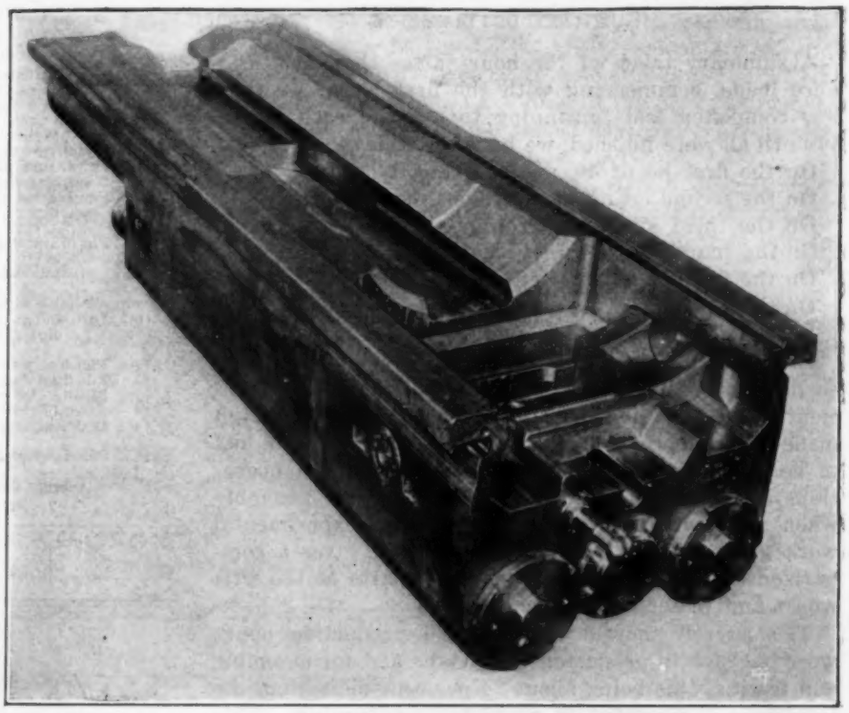


FIG. 49. A COMPLETED RECUPERATOR

operations on the sleigh and to assemble the parts into it, but not including the labor of producing the component parts, was estimated at approximately 1,000 hr.

on the basis of making 814 recuperators which was the quantity specified in the first order. The number required was reduced to 280 and this quantity having been completed, it may be of interest to note the actual average productive time consumed in producing

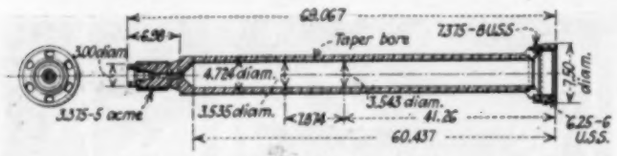


FIG. 50. THE BRAKE PISTON ROD

Sequence	Operation	Hours	Min.	Machine Tool Used
1	Spot turn and center	2	0	24 in. lathe
2	Rough bore	8	0	24 in. Libby turret lathe
3	Bore and ream	8	0	Stecher vertical boring mill
4	Spot turn and line up	1	30	18 in. lathe
5	Re-center, face and turn	1	0	20 in. lathe
6	Turn thread clearance and large diameter	1	0	20 in. lathe
7	Cut internal thread	2	0	Lees Bradner thread milling machine
8	Rough and finish turn outside diameter	5	30	20 in. lathe
9	Cut Acme thread on small end	1	0	Lees Bradner thread milling machine
10	Drill 6—1 $\frac{1}{16}$-in. holes	1	0	30 in. upright drilling machine
11	Finish grind all outside diameters	2	30	Cincinnati grinding machine
12	Finish turn all grooves, bevels and shoulders	1	45	20 in. lathe
13	Cut external thread on large end	1	45	Lees Bradner thread milling machine
14	Drill, ream, counterbore and tap small end	2	0	Barnes horizontal drilling machine
15	Assemble and finish turn piston liners	1	30	20 in. lathe

Hydrostatic test—4380 lb. per square inch—Time each, 1 hour, 30 minutes.
Elongation test—71.65 tons—Time each, 30 minutes.
Average time, each set, 81 hours.

the reduced quantity and the progress that was being made through improved methods and increased skill in the reduction of the average hours.

Summary of Time

A summary taken of the hours after the final tests were made, commencing with the first lot of 40 that was completed and continuing to average each lot of 40 until all were finished, we have the following results:

On the first lot of 40, average time 1,330 hr.
On the second lot of 40, average time 1,057 hr.
On the third lot of 40, average time 934 hr.
On the fourth lot of 40, average time 777 hr.
On the fifth lot of 40, average time 743 hr.
On the sixth lot of 40, average time 709 hr.
On the seventh lot of 40, average time 705 hr.

No effort had been made in the above to select for earlier assembly the sleighs that had been least efficiently machined nor were the operations on each sleigh made in sequence, and some of those in the later lots to be assembled doubtless had some individual operations completed at the commencement of the assembly when there was necessarily more or less experimental work going on. The accompanying table gives a comparison of the times on the principal parts at the Otis works and Watertown Arsenal.

The payroll showed that 312,000 productive hours were paid for in producing the sleighs and for assembly and testing, this being about 24 per cent more than the total time represented in completed recuperators. This difference is attributed to the work that was done on sleigh forgings and laid aside at the signing of the Armistice as not being required, also in the time spent on forgings that proved defective or were spoiled and in time lost in waiting for forging changes at the end of machining operations.

The following illustration will give a clearer idea of what was accomplished by improved methods in machining and the benefit derived from tabulating the daily

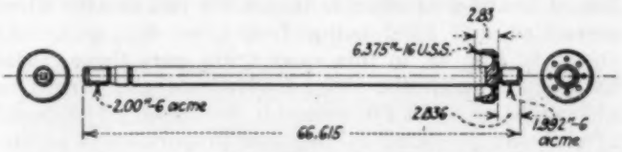


FIG. 52. RECUPERATOR PISTON ROD

Sequence	Operation	Hours	Min.	Machine Tool Used
1	Cut off	1	30	18 in. lathe
2	Center	0	30	18 in. lathe
3	Rough out piston	3	15	18 in. lathe
4	Spot turn	3	0	18 in. lathe
4-B	Finish all outside dia. for grinding	3	0	20 in. lathe
5	Finish grind all outside diameters	2	15	Cincinnati grinding machine
6	Finish grooves and taper inside piston	5	45	20 in. lathe
7-A-B	Cut Acme thread	1	30	Lees Bradner thread milling machine
8	Mill thread outside of piston	0	45	20 in. lathe
9	Drill and counterbore for square hole in end	0	15	20 in. lathe
10	Broach square hole	0	45	.....
11	Drill and assemble	2	30	24 in. upright drilling machine

One rod required. Total time, 25 hours

operations, thereby being prepared with each succeeding day to do a little better.

The greatest time on each operation, selected in ten instances from the time sheets on 280 completed recuperators, showed a total of 1,446 hr. to complete the series of operations, while the time sheets in ten other in-

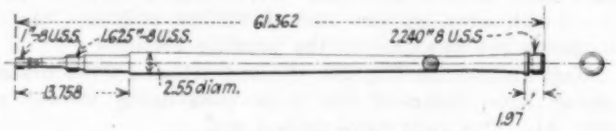


FIG. 53. THROTTLING ROD

Sequence	Operation	Hours	Min.	Machine Tool Used
1	Cut off to length and center both ends	1	30	18 in. lathe
2	Rough and spot turn	3	0	18 in. lathe
3	Rough turn all over to +.060 size	1	0	Fitchburg 3½ in. lathe
4	Rough turn throttling curve	2	30	Fitchburg 3½ in. lathe
5	Finish turn all straight diameter for grinding	0	45	18 in. lathe
6	Finish grind all straight diameters	0	45	Cincinnati grinding machine
7	Finish turn all shoulders, fillets, etc.	2	30	18 in. lathe
8	Cut all threads	1	0	Lees Bradner thread milling machine
9	Assemble with 38253-4	0	15	.....
10	Drill and ream $\frac{7}{8}$ in. hole for pin	0	15	24 in. upright drilling machine
11	Finish turn throttling curve	1	30	18 in. lathe
12	File throttling curve	2	0	18 in. lathe
13	Mill flats for wrench	0	30	Bristol milling machine
14	Assemble with 32253	0	15	.....
15	Drill and ream ½ in. hole	0	15	24 in. upright drilling machine
16	Grind valves	0	30	Cincinnati grinding machine

Average time, each set, 37 hours

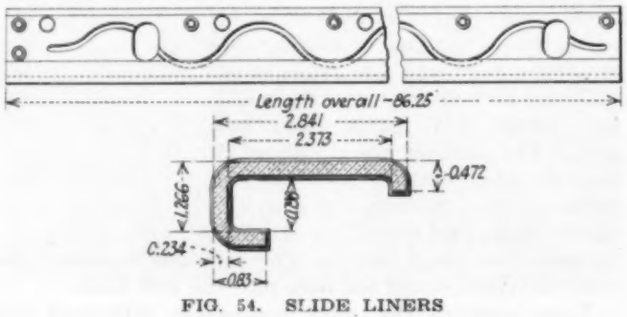


FIG. 54. SLIDE LINERS

Two extruded bronze liners required for each sleigh. The liners were drawn to $\frac{1}{32}$ in. of finished dimensions and were planed on the outside. Average planing time, each set, 3 hours. Milling five oil recesses in each liner, time each set, 1 hour. Drilling rivet holes, time each set, 1 hour. The inside of slide liners were machined in milling operation, No. 45. The oil grooves were machined in operation No. 46.

Total machine time, each set, 12 hours.

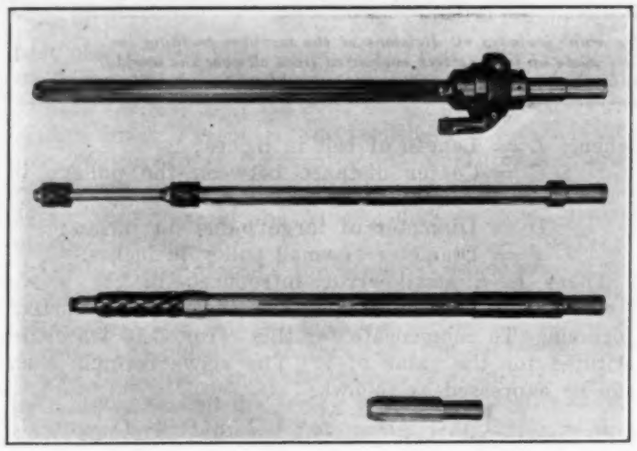


FIG. 51. BORING AND REAMING TOOLS

stances showed that the least number of hours on each operation totaled 552½ hr. and this time could readily have been maintained by securing the co-operation of the workmen and in continuing the machining operations that were finally adopted.

COMPARATIVE SUMMARY OF MACHINE AND FLOOR WORK HOURS COMBINING VARIOUS PRINCIPAL OPERATIONS ON THE SLEIGH, INCLUDING THE ASSEMBLY OF COMPONENT SMALL PARTS INTO THE SLEIGH.

	Watertown Arsenal:	Otis Elevator Co.:
Average time on all roughing and finishing machine operations on top of sleigh, including the gun seats and for looking blocks	271.16	205.86
Average time on all roughing and finishing machine operations on the bottom of sleigh except that portion which is beneath the reservoirs	29.12	53.39
Average time on all roughing and finishing machine operations required for machining the ends of the sleigh and underneath the reservoirs	64.99	31.54
Average time on rough and finish machining both sides to angle	29.61	16.66
Average time on all rough and finish machine operations required to form the seats for slide runners and for machining the inside of liners	75.83	29.90
Average time in drilling and finish reaming the cylinders and reservoirs and in lapping the cylinders, includes counterbores and threading	153.70	175.31
Average time on drilling and tapping all holes —(Not cylinders or reservoirs)	54.71	56.34
Average time on all floor work	172.43	146.06
Total hours	851.55	715.06

Rewards for Suggestions

BY RICHARD J. JACKER

I was employed in a large factory in Chicago as a mechanical draftsman and machine designer. In a number of places in the plant were suggestion boxes stating that the management would reward employees for suggestions which resulted in a benefit. I noticed that several men in a certain department were in the habit of playing pranks on others and carried the matter far beyond reason, even destroying personal property of some of the men. There was a general antagonistic feeling among the men of the department which interfered greatly with the men getting out the normal amount of work.

I placed a suggestion in one of the boxes saying that the antagonistic spirit among the men of that department was interfering with their efficiency and suggested that something be done to cultivate a friendly and helpful feeling among the men. The next day the foreman of the department laid my written suggestion before me and asked if I wrote it. I replied yes. He then repeated a very sarcastic remark regarding the same which he told me was made by one of the officials of the company who has charge of the suggestion boxes, and added some uncalled for remarks by himself, which dampened my ardor for making suggestions in the future.

It seems to me that the cultivation of good fellowship and a helpful spirit among the men is as important as the saving of unnecessary steps or operations in a large factory where efficiency is desirable. It may be that my suggestion would have gone a different course if more than one person had passed on it.

[Suggestions should be considered by a committee that is familiar with the practical conditions in the shop. There are few cases where one man is capable of dealing with them all to the best interests of all concerned.—EDITOR.]

The Use of Grindstones in Axe Manufacturing

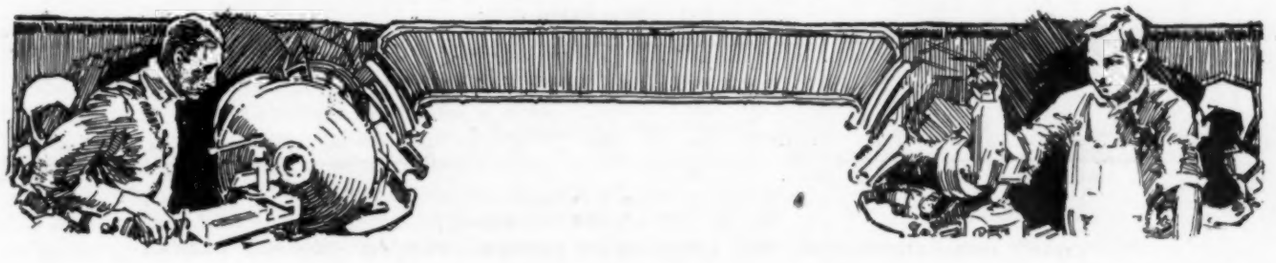
BY CHARLES HEATERS

Brades Steel Works, England

On page 1,001, vol. 54, of *American Machinist*, appeared an article on wet grinding. I have had the privilege of witnessing the operation of grinding axes by grindstones in the U. S. A. at various times, and have considered it the most injurious occupation I have ever seen, especially the grinding of the heads and edges of the axes, which is done almost dry, and consequently produces a great amount of dust.

The report of the U. S. Public Health Service does not appear to draw attention to the particular reason for the injurious nature of this dust, which is due to the grindstones being composed mainly of silica, and which is liable to cause a special disease of the lungs called silico-fibrosis or "grinders' phthisis." The same disease occurs with the workers in ganister (another silicia) grinding mills, and in silicia brick manufacture.

We understand that the principal manufacturers of axes and similar tools in the United States have abandoned the use of grindstones in favor of artificial wheels. My firm makes over 1,000 axes and hatchets per day, all of which are ground in the same way. Incidentially the artificial wheels cost considerably less, per hundred axes ground, than the sandstones.



Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

Chart for Determining Belt Lengths

BY DAVID TURCOTT

The chart accompanying this article was designed for the purpose of simplifying calculations of belt lengths. By means of this chart the length of a belt can be found with sufficient accuracy, and in less time than is possible by any of the belt formulas. The chart is also useful for finding the distance between the centers of the pulleys when only the vertical and horizontal distances between them are given.

The following formulas served as a basis for the design of the chart:

$$L = 2\sqrt{C^2 + \left(\frac{D-d}{2}\right)^2} + \frac{\pi(D+d)}{2}$$

$$= \textit{Length of Open Belt;}$$

$$L = 2\sqrt{C^2 + \left(\frac{D+d}{2}\right)^2} + \frac{\pi(d+d)}{2}$$

$$= \textit{Length of Crossed Belt;}$$

when, L = Length of belt in inches;
C = Center distance between the pulleys in inches;
D = Diameter of large pulley in inches;
d = Diameter of small pulley in inches.

There is a small error introduced in the above formulas, as compared with the theoretically correct formula. To compensate for this error, 3.16 was substituted for the value of π. The above formula then can be expressed as follows:

$$L = \sqrt{(2C)^2 + (D-d)^2} + 1.58(D+d)$$

$$= \textit{Length of Open Belt;}$$

$$L = \sqrt{(2C)^2 + (D-d)^2} + 1.58(D+d)$$

$$= \textit{Length of Crossed Belt.}$$

These formulas are easily solved by aligning various lines on the chart, as explained in the following example:

Let it be required to find the length of an open belt to pass over two pulleys 28 and 6½ in. in diameter

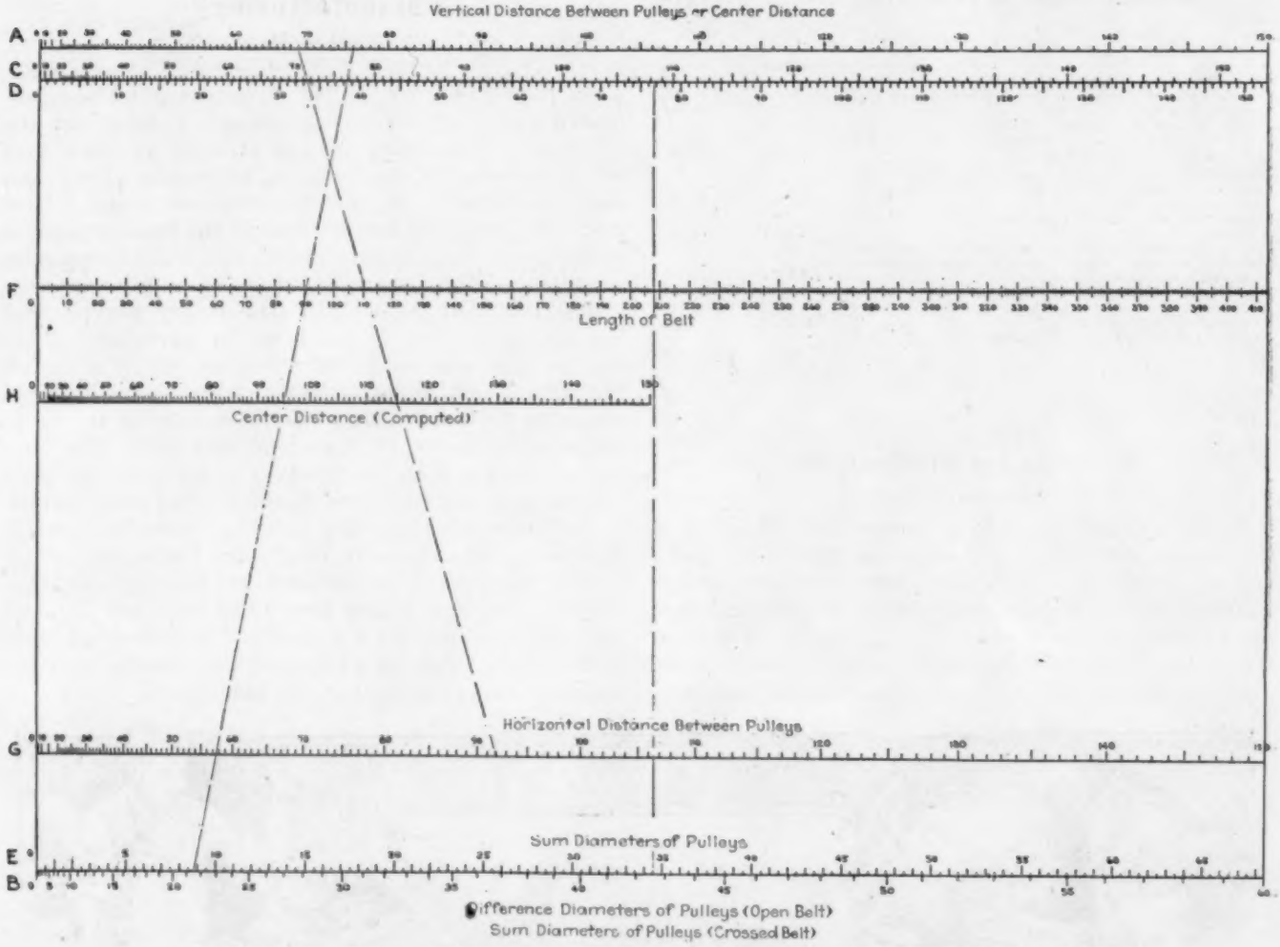


CHART FOR CALCULATING THE LENGTHS OF EITHER OPEN OR CROSSED BELTS

with a center distance of 76 in. Read the center distance 76 on scale *A* and the difference between the pulley diameters or 21.5 on *B*, and lay a straight-edge across these two points as indicated by the broken line. The straight-edge will cut 76.8 on scale *C*.

Now read 76.8 on scale *D* and align this point with the sum of the diameters (34.5) on scale *E*. The straight-edge will then cut out 208 on the line representing the length of the belt, scale *F*, as shown by the broken line. Therefore, the length of the belt is 208 in. The procedure for finding the length of a crossed belt is the same, except that on the scale *B* the sum of the diameters of the pulleys must be read, instead of the difference.

In the above example the center distance was given, but it frequently occurs in practice that the drawing gives only the vertical and the horizontal distances between the pulleys. In this case the center distance can be found with the aid of scales *A*, *G* and *H*. Let it be required to find the center distance between two pulleys when the vertical distance between them equals 69 in. and the horizontal distance 92 in. Read 69 on scale *A* and 92 on scale *G*, and align these points with the straight-edge. The point through which the straight-edge will pass on scale *H* will represent the center distance. In this example the center distance equals 115 in., which distance can now be used for finding the length of the belt in the manner already explained.

In order to show just how the length of a belt, as determined by means of the chart, varies from the theoretical length, the accompanying table was prepared. The theoretical length was calculated with the aid of a six-place table of logarithms.

TABLE COMPARING CALCULATED RESULTS WITH THOSE OBTAINED FROM CHART

D in Inches	d in Inches	C in Inches	Theoretical Length, in Inches	Length from Chart, in Inches
		OPEN BELTS		
32	18	112	302.977	303.0
20	5	20	82.114	82.2
28	6½	76	207.709	208.0
		CROSSED BELTS		
9.44	4.69	110	242.659	243.0
15	10	108	256.715	257.0

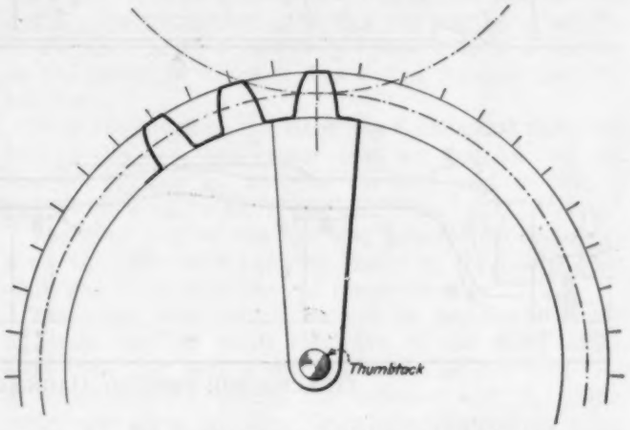
The chart was designed for center distances not exceeding 150 in. When the center distance is longer, divide all given dimensions by 2 and find the length, as usual. The result will represent only one-half of the actual length and, therefore, must be multiplied by 2. In this manner the same chart can be used for center distances up to 25 ft. For accurate results, an allowance can be made for the thickness of the belt by adding the thickness of the belt to the diameter of each pulley. If, for instance, the diameters are 18 and 5½ in., and the belt is ¼ in. thick, figure the belt length as for 18.25- and 5.5-in. pulleys.

Drawing Gear Teeth Rapidly

BY HOMER S. TRECARTIN

The work of laying out gear teeth should not be shirked on a finished assembly view, as it adds greatly to the good appearance and clearness of a drawing to have the gear teeth detailed. I applied a little time-saving idea to this work, which proved better than anything I know of for rapid detailing.

I laid out one gear tooth accurately on a piece of stiff paper. Then I carefully cut this out for a template, including in the piece the center point of the gear circle. I drew in pencil on the drawing, the circles for the outside diameters of the gears, and spaced them off for the proper number of teeth. On the center line of my template I pricked a small hole at the proper radius from the original line and fastened it over the gear



USING TEMPLATE IN DETAILING GEARS

center with a thumbtack, as shown by the accompanying illustration.

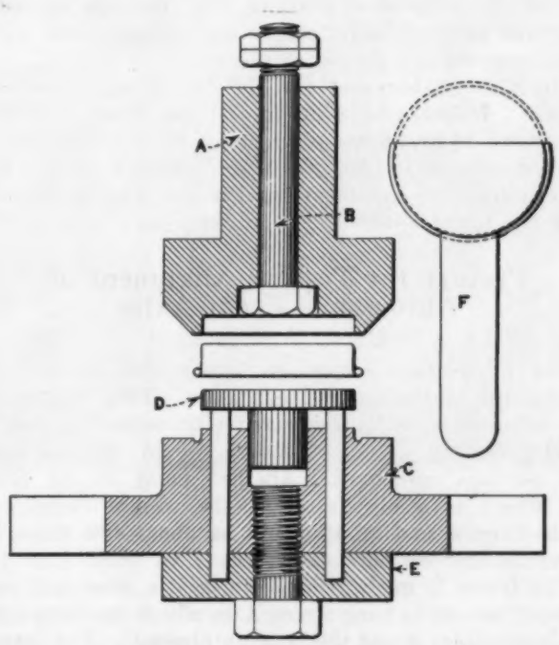
It was easy to locate this template for each tooth, by indexing its center line to the spacing marks on the circle. The outline of the gear was thus quickly drawn, either with a pencil or with a drawing pen.

A Cover Curling Die

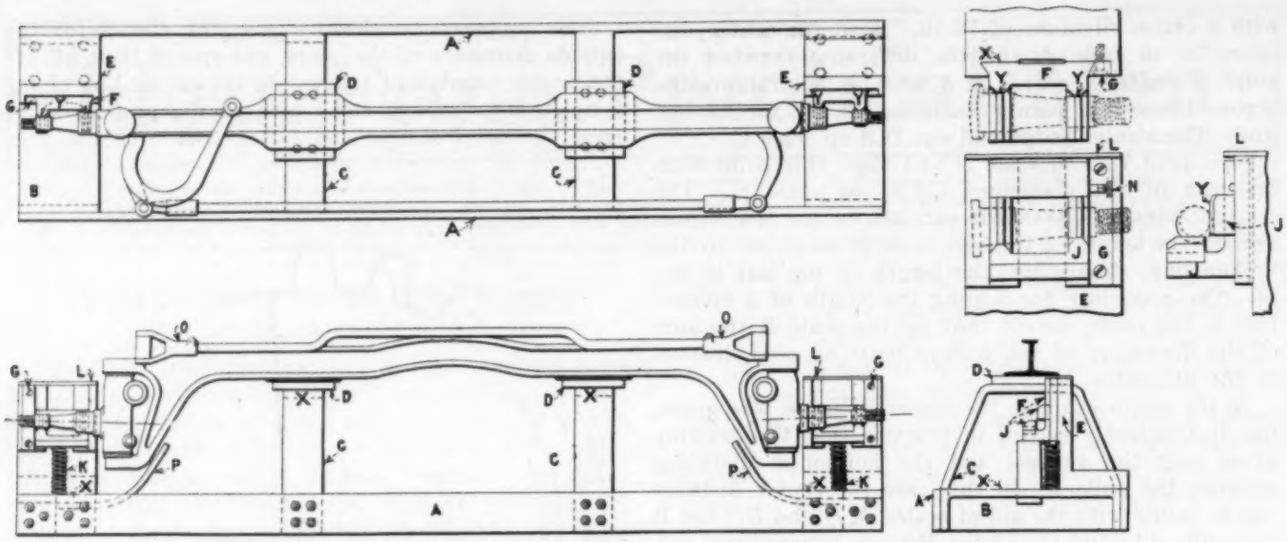
BY S. A. MCDONALD

We received an order for 25,000 curled covers which were wanted in a hurry and, as there was no likelihood of a repeat order, it was necessary to get out the dies as cheaply as possible. The cover had originally been made without the curl, so it was only necessary to make the curling die.

The punch and die as shown in Fig. 1 were made as follows: An old drawing punch *A* was rescued from the



A CURLING DIE QUICKLY MADE



FIXTURE FOR TESTING ALIGNMENT OF AUTOMOBILE FRONT AXLES

scrap bin, and the cutting edge turned off. A recess was then made to fit the cover, and the inside of the punch was bored to take the head of a ½-in. capscrew *B*, which acted as a knockout. Next, an old shoe *C* was found that could be turned off and used. It was set up in a lathe and the groove formed and the hole bored to take the cold-rolled steel die center *D*.

The cast-iron washer *E* was then bolted to the shoe, a ⅜-in. capscrew being used for the purpose. Holes for the four pressure pins were drilled through the shoe and into the washer; the washer then being removed and a larger size drill run through the shoe to give clearance for the pins. The pins were made a drive fit into the washer and filed off to length. The usual stem, rubber pad, lower washer, and nut were used.

As the size of the order did not warrant a feed chute or guard, a pick was made by soldering a piece of steel to a part of a cover as shown at *F*, thus making it unnecessary for the operator to put her fingers under the punch.

While I would not recommend using cast iron for a curling die as general practice, for this size of order it proved perfectly satisfactory and showed little signs of wear at the completion of the order.

The direct labor cost for the die including setting up was: Diemakers—8 hr. at 65c. per hour = $5.20; Operator—15 hr. at 30c. per hour = $4.50; total, $9.70.

What we got for the job I am ashamed to say, but the customer was as pleased with the price as he was with the speed with which the order was filled.

Fixture for Testing Alignment of Automobile Front Axles

BY C. F. GEORGE

The illustration shows an inexpensive fixture for testing the alignment of front axles. This framework can be made very quickly, and eliminates the use of a main casting which, of course, would need patterns and perhaps coreboxes. Another point in its favor and which is a big factor is the weight saved. If made from a casting it would be about five times as heavy as the one here described.

The frame is made from 2½-in. x ½-in. steel and consists of two main base pieces *A* to which are bolted the platform pieces *B* and the housing pieces *C*. The framework is machined at the places marked *X*. Two hardened-steel machined pieces *D* are bolted to the housings *C*, which locate the axle spring pads.

The actual testing parts of the fixture can be readily seen and consist of angle brackets *E* which can either be made from castings or forgings as desired. They are machined to take the slides *F* which are held in position by the machined gibs *G*.

Screwed to the slides *F* are hardened-steel locating pieces *J* which can be renewed when necessary. The slides are operated by the coiled springs *K* and are prevented from sliding out by the plate retainers *L*. Two locating pieces *P* are bolted to the framework to locate the axle endwise.

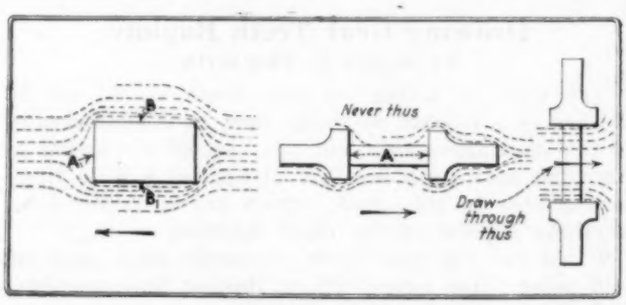
The operation of the fixture is simplicity itself. The axles come from the assemblers and are placed on the fixture as illustrated. The indicators *N* on each end at once show the difference between the height of the axle spring pads and the wheel spindles. The alignment is seen immediately by looking at either end of the fixture and if the spindles do not touch all four points marked *Y*, the necessary adjustment can be made by resetting the threaded parts *O* backward or forward as desired.

Quenching Carbon Steel to Avoid Soft Spots

BY W. C. BETZ

Some of the readers may recall times when a piece of water-hardened tool steel would have soft spots while the surrounding metal was glass hard.

The writer has had this experience on small embossing dies and the pads of gages and has found the cause in the method of quenching. If a piece is drawn through the quenching solution, as shown in the sketch, the



QUENCHING CARBON STEEL TO AVOID SOFT SPOTS

section *A* in the direction of travel will invariably be found soft and the sides *B* and *B* will be uniformly hard. This can only be accounted for by the fact that an air pocket is formed in the center of the piece being quenched as it is drawn through the water, and as the water passes each edge of the center it cools the metal quicker near the edge and the sides *B* and *B*. On oil quenching steel this phenomena does not seem to appear.

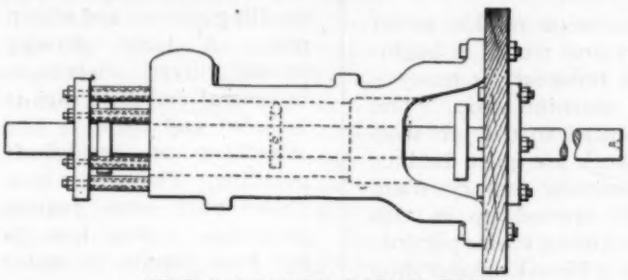
Boring a Gas Engine Cylinder

BY R. MCHENRY

Some years ago we were required to rebore an unweildy gas engine cylinder, removing as little metal as possible from the bore and doing the job in the least possible time, as it would not warrant the expenditure of any great amount of money.

The engine in question was of a heavy vertical type, about 6-in. bore and with a long stroke. From the upper end of the cylinder there protruded six long studs for holding the cylinder head. The lower end of the casting terminated in what may be termed "feet" where it joined the open crankcase.

The boss was soon convinced that the cylinder would not swing in our old 20-in. lathe and for various reasons neither could it be strapped to the carriage for



SELF-CONTAINED BORING RIG

boring with a bar on centers. It was generally agreed among the "hands" that the "Old Man" had "bit off more than he could chew."

A long boring bar was made by cutting off a smooth straight piece of 3 7/16-in. shafting and fitting it with a cutting tool and setscrew near the center of its length. Four disks or plates of cast iron, approximately 1 in. thick, were next procured and a 3 7/16-in. hole bored through each to a nice sliding fit on the bar.

As the travel of the piston did not include the entire length of the bore the inside of the cylinder was smooth and true for a short distance at each end. Two of the disks were therefore turned on the outside (concentric with the hole) to a snug fit in these ends.

The other two disks were some 3 or 4 in. larger in diameter and were faced off on one side square with the hole. One of them was laid out for six holes, corresponding to the studs of the cylinder but drilled to 1/8 in. larger. The other had four 3/8-in. bolt holes drilled on the quarters and near the outer edge.

Next, six pieces of 3/4-in. pipe were carefully squared in the lathe to equal length, which was 2 in. less than that of the studs. About 2 ft. of hardwood plank having a 4-in. hole cut in the center and a few iron bolts completed the "tooling up" for the job.

One of the smaller disks was entered part way in the cylinder at the crankcase end. The plank was then bolted across the "feet" so that the 4-in. hole was in line with the bore of the cylinder. Next, the bar was slipped through both plank and disk until it protruded from the opposite end of the cylinder. The other small disk was then put on this end of the bar and entered in the open end of the bore.

After placing the pieces of pipe over the studs, the disk with the six holes was brought up and slid along both bar and studs until its faced side rested against the pipes. The stud nuts were then applied and screwed home. The remaining disk was put on the other end of the shaft and its faced side brought up to a bearing on the plank, to which it was bolted through the four bolt holes.

With the chuck on the lathe, the tailstock at the lower end of the bed, the center rest set for 3 7/16 in. and clamped farther up, and the carriage next in line, it was short work to set in the rig.

The head end of the bar was gripped in the chuck jaws, the other end running freely in the center-rest, while the plank was close to the cross-slide.

The small disks which, as will be seen, served only to locate the bar while clamping to the outer disks, were then slid back a few inches. The bar was free to turn centrally within the cylinder and the latter easily rode along the bar. Openings between the studs and the feet allowed for setting the tool and inspecting the boring so all that remained was to connect the piece of plank loosely to the carriage which supplied the feed movement.

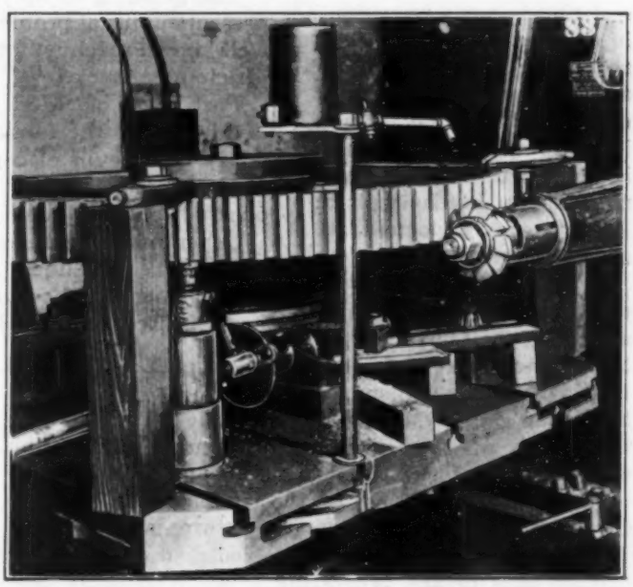
Cutting a Large Gear on a Boring Machine

SPECIAL CORRESPONDENCE

The illustration shows how the Stevenson Gear Co., Indianapolis, Ind., used a Gidding & Lewis boring machine as a gear cutter for a large job. The gear is 48 in. in diameter, 4-in. face and 3 diametrical pitch.

A Milwaukee dividing head was procured, which was guaranteed accurate within 0.001 in. at 10-in. radius; it was rigged up on the table as shown.

The gear was mounted on a mandrel turned by the dividing head. The outer edge of the gear was sup-



CUTTING A LARGE GEAR ON A BORING MACHINE

ported by blocking and screw jacks at several points, and held down by the straps as shown. The clamps were of course, released for indexing.

In spite of the overhang of the cutter, due to the extension necessary to reach the center, the gear was smoothly cut and proved satisfactory in every way.

IN THIS ISSUE

AS ANNOUNCED on this page last week the leading article in this issue describes the manufacture of the crankshaft used in the Rolls-Royce automobile. The description concerns only the heat-treating, machining and testing operations performed on the shaft after it has reached the Springfield plant. The number of grinding operations performed is significant of the quality of the work done and consequently of the product turned out. It may be noted in this connection that there is also a large amount of skill employed in the forging operations performed at another plant before the shaft gets to Rolls-Royce. We hope to have something for you on this forging practice in the near future.

The fifth section of Prof. McCabe's "Economics of Production" gives the elementary theory underlying the present situation of business. He begins, "We have now considered what happens and what action is called for when there is a falling off in demand after a big forward movement. The discussion will turn on prices and costs." If anything could be more timely than this we can't imagine what it might be. Further on he says, "Every reduction in cost that is not a reduction in earnings helps to bring about the renewal of demand and production and makes reduction in earnings less necessary." This is excellent theory under present conditions, but isn't it equally logical at any time?

Page 456 sees the beginning of the concluding article on the tools used in the manufacture of the Pratt & Whitney adjustable limit snap-gages. Mr. Sheldon has gone thoroughly into the details of this exceptionally accurate production work and a study of his illustrations and description is well worth while. Most of the current installment is devoted to grinding and lapping fixtures and methods.

Part XV of "Metal Cutting Tools" discusses gear cutting tools of the generating type. The action and design of the Fellows and Gleason cutters are analyzed, and the author then proceeds to the theory of hob action. This part was too long for one number and will be continued next week.

Following Mr. DeLeeuw's article is another by Editor Colvin on automobile part making in the Peerless shops. Several differential gear parts are described.

Dowd & Curtis' "Tool Engineering" begins on page 468. The design of riveting fixtures is the general heading under which the authors take up riveting machines, types of rivets, ring staking tools and fixtures, ejectors and various other matters connected with riveting practice. There is so much of interest in this article that we find it difficult to pick out any one feature to which to call your attention. The whole thing is invaluable.

The recent article on automobile cylinder regrinding has caused so much favorable comment that we are following it up this week with one on piston work in motor repairing. See page 473. This article is prepared particularly for men engaged in the more elaborate automobile engine repair work and contains boiled down directions for handling pistons and piston pins. A table showing manufacturers' clearances in several makes of cars is included and there is also something on crankshaft grinding. The article concludes with some general directions telling how to get best results in motor overhauling.

Incidentally, the cylinder grinding article brought out quite a broadside of criticism from the re-boring and reaming people as was to be expected. We do not intend to carry on a controversy between the exponents of the various refinishing methods in these pages but we will certainly give all sides a chance to be heard. We shall endeavor to get the various views into print at an early date as there is considerable activity in automobile repair stations at the present time. Many an old car is being doctored up to last another season.

The final section in the series on "Manufacturing with Special Machines vs. Standard Equipment" follows the piston article just mentioned. It tells of the lapping operations on the recuperator cylinders and the assembling and testing of the complete recuperator. The series is concluded with a summary of the time taken for the various lots in the two different shops and a general résumé of the whole subject.

Among the practical letters this week are several which stand out from the ordinary run. On page 480 David Turcott has a chart for simplifying the calculations involved in determining belt lengths.

Coming Features

The maintenance of our nine million or so automobile passenger cars and trucks is beginning to provide profitable business for many a large and small jobbing machine shop. The machining problems presented to the job shop manager by this kind of work are quite distinct from those of the automobile factory man. Perhaps the biggest field opened up in this direction is that of manufacturing repair pistons. The methods employed in a New England shop engaged in this work are described in our next issue.

The grinding of holes of irregular shape also presents unusual problems. How it is done on a well-known machine forms the basis for another article next week.

Part XXII of "Modern Production Methods" is devoted to the fundamentals of correct time study. The evils of careless or inaccurate time analysis are pointed out and general rules for the observer are laid down.

Other management articles will be found in the sixth installment of "Organization and Management of the Small Shop," and the sixth part of "Economics of Production."

EDITORIALS

On the Up Grade

THE recent wordy skirmish at a Washington banquet one for many months. During the days of inflated prosperity when he predicted the inevitable reaction the scoffers called him a calamity howler, or worse. In the end, however, he was vindicated by the worst industrial depression for years.

When he recovered a little spirit he mildly suggested that a resumption of business was due in the spring of 1921. But by this time the average man had concluded that the bottom had dropped out of everything and refused to be comforted. What was worse he sat back and waited for something to happen instead of digging in with every bit of strength and grit he could summon. Under this treatment the incipient boom struggled feebly but soon strangled to death under the oppressive weight of pessimism.

The next date set for the revival of business was Labor Day. Many were still unconverted but the more thoughtful realized that consumption was proceeding at almost normal rate and that before long surplus stocks would be gone. This condition has come sooner than was expected in some lines.

It is perhaps a little soon after Labor Day to tell whether or not a real revival is in progress, but all the surface signs point that way. Railroad earnings have increased and freight car loadings have done likewise. The position of the banking system is constantly gaining in strength and money rates are consequently decreasing. Textile and leather people are running nearly full time and automobile plants are doing more. Stock and bond prices are stiffening.

Even iron and steel markets are showing signs of life and that is most welcome news for men in the metal trades for there seems to be a definite relation between pig iron production and machinery sales. When iron is going strong there must be machine tools to convert it into marketable products and machine tools wear out or become obsolete in time.

Climbing up the business hill is harder work than sliding down, but the view from the top is far better than that from the bottom. We are just starting up. Let's keep going.

What About Spare Parts?

AN experience we have just had with an automobile service station leads us to do some more wondering on an old subject—the making of repair parts in dull times. Business has been so bad that we feel constrained to run our ancient car one more year although it has fully earned a rest. As a result certain replacements must be made.

We have taken it for granted for so long a time that during slack times manufacturers built up their reserves of repair parts so that a supply would be on hand when the factory was running full on production, that we were astounded to discover that not one of three commonly failing parts was available. The stock clerk complained that he had in orders for thousands of one of the parts in question but didn't know when he would get any.

The company making the car we drive ranks among the first five in volume of output and has not been running full time all summer but is now behind on orders. Evidently there is to be further delay in taking care of old customers.

We would be the last to advocate the manufacture of excessive quantities of spare parts with materials and wages both at high figures but there is certainly a happy medium between such a procedure and that of allowing parts reserves to be seriously depleted. It should not be a difficult matter to determine the rate at which various parts wear out and must be renewed, and from this to estimate the necessary stock to carry.

Perhaps this is only an isolated case and other manufacturers are in better shape. We hope so, but we have our doubts. Our experience certainly substantiates the findings of Mr. Hoover's committee on waste—that management is responsible for a goodly share of industrial inefficiency.

The End of Excess Profits Taxes

AS THIS is written it appears that the Senate will accept the House provision in the new revenue act which repeals the excess profits levy as of Jan. 1, 1922. To many business men it will make little difference whether the date when the appeal takes effect is that chosen by Congress or that recommended by Secretary Mellon. But few of them saw anything that looked even remotely like a profit during 1921.

The fact remains, however, that once more very definite campaign pledges have been ignored and the utter folly of believing anything promised by a politician has been demonstrated beyond question of doubt. The heads of the present administration should not be included in the general condemnation for they seem to have done their best to fulfill their pledges. They at least are far-sighted enough to see that such an unwise restriction of business as the excess profits tax has turned out to be in peace times should be removed at the earliest possible moment for the good of the country.

The Plain Unvarnished Truth

THE recent wordy skirmish at a Washington banquet between General Pershing and Samuel Gompers filled many an American citizen with silent joy. In view of the undisputed record of strikes called by organized labor leaders during the period of the war, it is rather galling to be reminded continually of the great share labor had in winning the war. General Pershing's remarks can hardly be discredited on the ground that he represents the capitalistic attitude antagonistic to labor. In fact, a more disinterested individual can hardly be named.

The labor profiteers were probably no worse than any of the other breeds produced by the war, but the others at least have not the hardihood to claim a large share in the ultimate victory.

Shop Equipment News

Pawling & Harnischfeger Boring, Drilling and Milling Machine

The illustration, Fig. 1, shows a horizontal boring, drilling and milling machine that has recently been developed by the Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. The machine is made in several sizes, the one illustrated being the No. 4-F, the smallest of the series. It is designed to drive high-speed steel tools to the limit of their capacity. The machine is intended chiefly for heavy milling and large boring operations, and can be used either as a single-purpose or as a general machine shop tool. The principal features in the machine to which the maker calls attention are the narrow guiding surfaces, the feed screws operating in tension, the provision for taking up wear on all sliding parts, and the centralized control.

The saddle carrying the spindle is of box section. It contains the drive mechanism for the spindle, the feed-change mechanism and the feed distributing mechanism. It is stated that the complete unit can be lifted and supported at any point when fully assembled, without fear of distortion. The drive gearing and shaft bearings are bronze bushed, and the main spindle sleeve bushing is of phosphor bronze, scraped to a slight taper to permit of taking up wear. The saddle is guided upon the column by a narrow guide placed at the front so as to be near the cutting tool. The feed screw is in tension and is placed in the center of the guide. The saddle is fully counter-balanced, the weight being located on the inside of the column. It is raised or lowered on the column by means of a bronze wormwheel actuated by a quick-pitch worm and running on a steel screw, the operation being performed either by hand, by power feed or by the quick traverse.

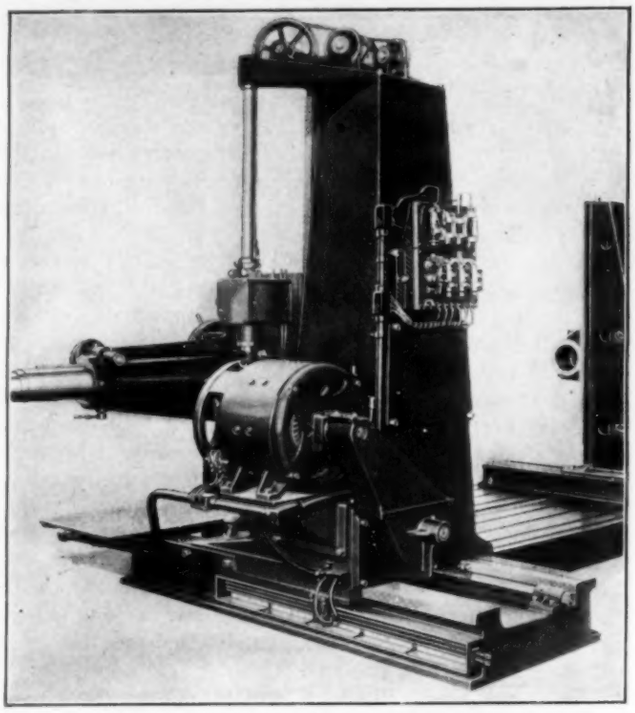


FIG. 2. REAR VIEW, SHOWING MOTOR DRIVE ON P. & H. BORING MACHINE

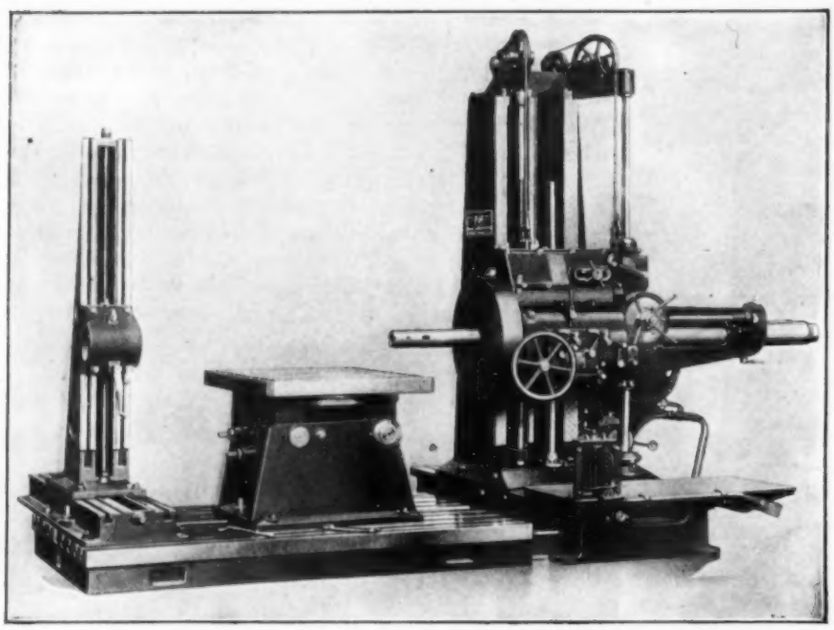


FIG. 1. PAWLING & HARNISCHFEGER NO. 4-F HORIZONTAL BORING, MILLING AND DRILLING MACHINE

Specifications: Diameter of spindle, 4 in. Taper hole in spindle, No. 6 Morse. Feed of spindle, 36 in. Vertical travel of spindle saddle, 48 in. Horizontal travel of column, 48 in. Speeds: number, 18; range, 5½ to 200 r.p.m. Drilling feeds: number, 8; range, 0.0076 to 0.45 in. per revolution. Milling feeds: number, 8; range, 0.009 to 0.54 in. per revolution. Rapid traverse, 60 ft. per min. Motor, 10 hp. Height of spindle from 9-in. bedplate: minimum, 25½ in.; maximum, 73½ in. Weight of machine without bedplate, outer support, tables or electrical equipment, approximately 17,000 lb.

The column is of box construction and has two sides straight and two sides tapered, a wide base being cast integral with it. It is guided by narrow guides on the front of the bed, the screw for feeding it being in tension and placed near the guide. The entire column can be traversed in either direction from the saddle by either the handwheel, power feed or rapid traverse. The bed or runway on which the column is mounted is also made of heavy box section.

The power is applied to the spindle at its front end, and the feed motion at its rear end through a rack and pinion. This construction provides for the spindle large bearings on both the front and rear. All feed changes are made by spur gears and positive clutches. The drive is delivered to the spindle from the gears in the saddle through either a small faceplate having a wide-faced spur gear or through a large faceplate having an internal gear.

There are eight boring and drilling feeds for the spindle, these being provided in either direction and ranging from 0.0076 to 0.45 in. per revolution of the spindle. The milling feeds to the column and saddle, which are also provided in both directions, are eight in number and range from 0.009 to 0.54 in. per revolution of the spindle. These feeds are driven directly from the spindle. A rapid power traverse independent of the feed is transmitted to the saddle and column, having a constant speed of 60 ft. per minute.

All of the operating levers and handwheels are located within easy reach of the operator, being for the most part mounted on the saddle. The control of all movements, feeds and speeds is effected by the operator from the platform attached to the front of the column. It is said that the movements of the levers are inter-locking, so that it is not possible to have any two conflicting speeds or feeds engaged at the same time.

The drive is from either a constant-speed motor variable-speed motor or by belt. When a motor is used, it is mounted on the side of the base of the column, as can be seen in Fig. 2, and moves with it. The machine requires a 10-hp. motor, but when direct current is used a two to one speed variation is employed. Since the machine is double back-geared, eighteen spindle speeds are obtainable for each direction, the range being from 5½ to 200 revolutions per minute.

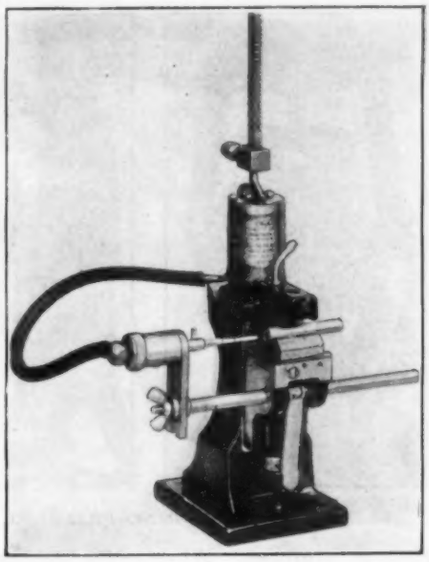
The bed on which the work is mounted can be furnished in any desired size and is provided with T-slots run parallel to the spindle travel. The outer support is ordinarily made with a 48 in. vertical and 48 in. horizontal traverse. It is adapted for supporting boring bars. A universal tilting and revolving table or a plain revolving table, with movement by either hand or power, can be furnished. Also, a screw-chasing attachment can be supplied, to cut threads from 2 to 16 per inch.

Caulkins Automatic Drilling Jig

E. L. Krag & Co., 50 West Randolph St., Chicago, Ill., has recently placed on the market the Caulkins automatic drilling jig, shown in the accompanying illustration. The device is intended for mounting on the table of a sensitive drilling machine that is employed on parts made in large quantities. It can be attached to any make of high-speed sensitive drilling machine, but is especially suited for use on the Avey No. ½ and Leland-Gifford machines.

The purpose of the device is to leave the hands free to manipulate the work that is being put in the machine, the operator controlling the clamping, the drilling and the discharging of the piece by a pedal. The rack at the top of the device runs on a gear on the feed shaft in the head of the drilling machine. This shaft, ordinarily turned by hand by means of a small lever, is connected to the pedal, so that when pressure is applied by the foot the drill is fed to the work and the jig is operated. It is said to be possible thus to keep the drill cutting nearly continuously, so as to conserve time in the performance of a job. The method of operation is particularly adapted to the drilling of cotter-pin holes up to ⅛ in. in diameter.

The clamping of the work is done automatically, and the tripping of the feed is also automatic, so that the drill is not fed to too great a depth. When the drill is allowed to rise, the work is automatically ejected, and the operator can insert a new piece by hand. For drilling such work as pins, grooved blocks are used to hold the parts. More elaborate holders can be made, however, for work requiring more operations. It is thus possible, it is claimed, to perform indexing, cross-drilling, or drilling two or more holes in one piece.



CAULKINS AUTOMATIC DRILLING JIG

An automatic lubrication system can also be supplied, the cutting fluid being automatically turned on and off by means of the mechanism connected with the pedal, so that it requires no further attention and flows only while the drill is cutting. The maker calls attention to the fact that the jig requires no belt, and that it is very effective in its operation. It is claimed for it that a great reduction can be made in the time required to perform drilling operation on small parts.

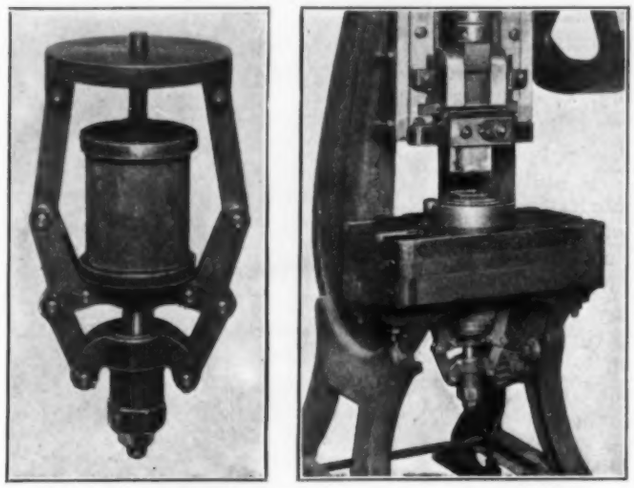
Bliss Spring-Pressure Combination Die Attachment

The E. W. Bliss Co., Brooklyn, N. Y., has recently placed on the market a spring-pressure attachment, shown at the left of the accompanying illustration, for use on small punch presses equipped with combination dies. On the right of the illustration is shown the attachment mounted on the No. 20 press. A toggle motion is used to give a uniform pressure on the blank during the entire draw, thus reducing the total rubber or spring compression.

It is claimed for the attachment that the strain on the press is reduced by its use, and a saving of the power required to operate the press is effected. Because of the reduction in the compression, the life of the rubber or spring should be materially increased. Reduction of the compression is also said to permit of the use of combination and reducing dies for drawing shells deeper than ordinarily made in that manner. Certain types of parts usually made with double-action dies can thus be handled. It should be noted, the maker states, that, when drawing in one operation shells of greater depth than ordinarily made by that method, correct working proportions between the diameter and the depth of shell must be maintained. The elimination of the accumulative spring pressure and the use of the uniform pressure causes, it is said, a reduction in the strain on the metal and in the wear on the dies, and gives a more uniform edge to the work. Back lash on the upward stroke is reduced because of the lessened spring compression.

The attachment is regularly made in four sizes, to

fit standard Bliss presses. The depth of the draw obtainable is 1¼ in. for the No. 18 press, 1½ for the No. 19, 2 in. for the No. 20, and 2½ in. for the No. 21 press. The attachment does not interfere with the operator, and the dies can be removed the same way as in the old



BLISS UNIFORM SPRING PRESSURE ATTACHMENT

style attachment. When ordering the dies it is necessary to specify the size of the tap hole for the spring barrel stem, but no change in the press is necessary when installing.

Bowser Oil Reclaiming Outfit

S. F. Bowser & Co., Inc., Fort Wayne, Ind., is placing on the market the oil reclaiming outfit shown in the accompanying illustration. The apparatus can be adapted to the reclaiming of different sorts of lubricating oils, but it is especially intended for use on oils employed in internal combustion engines. Since the oil in the crankcase of such an engine becomes diluted by the presence of the fuel which escapes into it, it is necessary to remove the gasoline, as well as to remove all dirt, grit and particles of metal which become entrained in the oil. The apparatus is said to perform both of these functions, and to restore the oil to its original condition as to viscosity, flash-point and purity, so that it can be used indefinitely. It is urged that the oil be changed much oftener than ordinarily done, the life of the motor being prolonged by the use of clean oil.

The oil reclaimer is ordinarily manufactured in two sizes, one having a capacity of 50 and the other of 100 gal. per 24 hours. The reclaimer proper, which is the large tank shown at the center of the illustration, is made of 14-gage galvanized steel and supported on legs made of angle iron. It is provided with the necessary inlet and outlet flanges, valves, gage glasses, thermometer and draw-off funnel. It requires a floor space of 54 x 72 in. and has an overall height of 6 ft. 8 in. in the 100-gal. size, the dimensions being 40 x 60 in.; and 6 ft. 11 in. for the 50-gal. outfit. The reclaimer can also be furnished in a 500-gal. size, for large establishments.

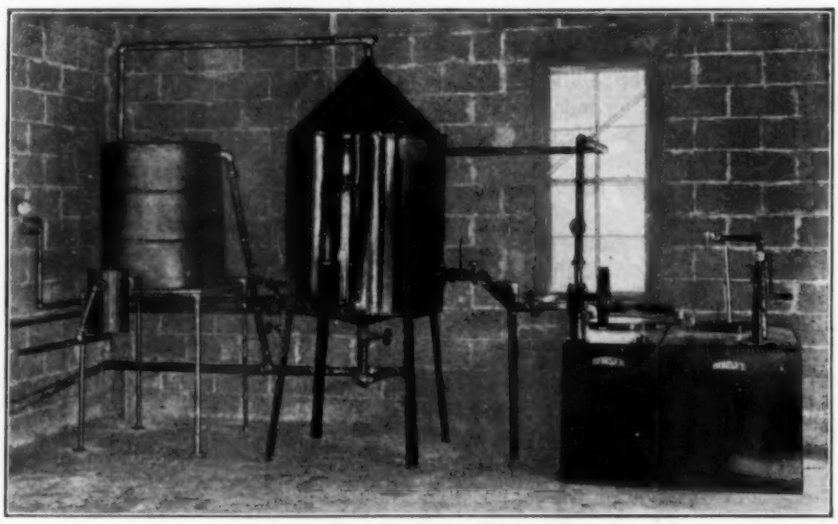
The large rectangular tank at the right of the illustration is for the clean oil, it being provided with a manhole and a cover and a 1 gal. hand-operated measuring pump, as well as means for admitting oil from the reclaimer. It has a capacity of 1 bbl. for the 50-gal. size and of 3 bbl. for the 100-gal. reclaimer. The tank for the dirty oil is also made of 14-gage galvanized steel, and is equipped with a 15-in. manhole and pressed steel cover, a drain for the reclaimer, and a hand rotary pump. The 50-gal. apparatus uses only a 1 bbl. tank, while a 2-bbl. tank is used for the 100-gal. size.

The apparatus shown at the left of the illustration is a still and condenser, which takes care of the fumes created in the distilling process and removes the gasoline from the oil. This action is accomplished by means of steam, while the precipitation of the foreign matter in the oil is hastened by means of a coagulant that is added. It is claimed that the approximate cost of operating the apparatus, including the cost for labor and steam, is about five cents per gallon.

Accessories for the apparatus can be furnished if desired. For the handling of the barrels a chain hoist and barrel drainer can be supplied. A transfer pump can be provided for handling the dirty oil, or a barrel cradle, track and chain hoist can be used. In case steam pressure is not available, a steam boiler, either gas or coal fired, can be furnished. Because of the fact that the conditions affecting each installation vary, the pipes and fittings are not furnished as a part of the standard equipment, but are made up to suit the measurements of the particular installation. The tanks can also be supplied to suit special needs, those intended for the 100-gal. reclaimer being furnished with the 50-gal unit if desired.

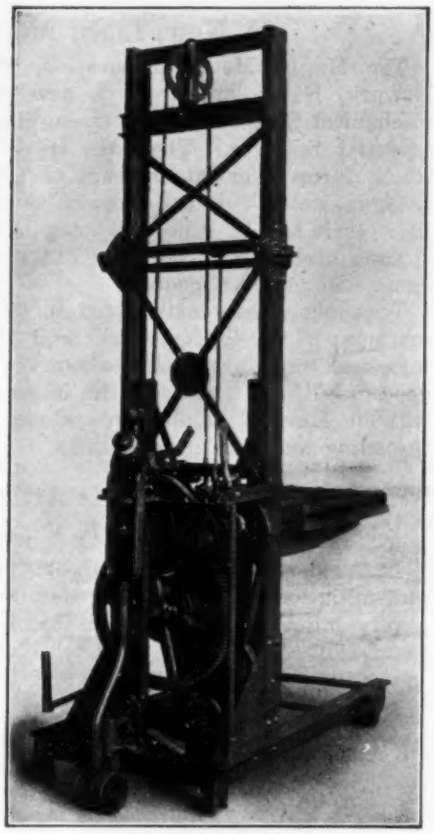
"Little Lifter" Portable Elevator

A portable elevator for lifting and tiering materials has been placed on the market by the Economy Engineering Co., 2635 W. Van Buren St., Chicago, Ill. The machine, shown in the accompanying illustration and known as the "Little Lifter," is operated by an electric motor. The difference between this elevator and those made by the concern in the past lies principally in the fact that it can be operated from the ordinary 660-watt



BOWSER OIL RECLAIMER

lighting socket, and that it can be hand-operated as well. Since it is equipped with a ½-hp. motor, the lighting circuit is not overloaded at the rated capacity of the machine. The speeds of the platform vary from 7 ft. per minute in the 1,000-lb. capacity machine to 12 ft. per minute for the size having 500-lb. capacity. The hand crank can be applied in the same way as for the ordinary hand - operated machines, making a machine for combination service and one that does not require special power wiring for its operation.

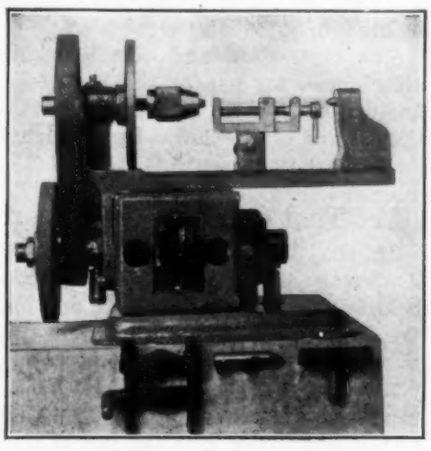


"LITTLE LIFTER" PORTABLE ELEVATOR

Details of construction adding to the convenience of the machine consist of the automatic adjustable stop device, limiting the travel of the platform to any height desired, and the gravity hand brake, for holding the load at any point of travel.

Utility Lathe

The Electric Motor Manufacturing Co., Ludington, Mich., has recently placed on the market the Utility lathe, shown in the illustration, for use where a small machining unit is required, as in the repair shop, on the farm, in stores, trade schools or laboratories. The machine can handle a considerable range of repair work in places where electric current is available for power. It consists of a lathe, drill press, and grinding wheel, all driven by one electric motor, on the housing of which it is mounted, being intended for bench use. The grinding wheel is mounted directly on the motor shaft, so as to give it the required speed. The spindle of the lathe is driven by covered gears from the motor shaft, and is provided with a faceplate. A center point can be inserted in the spindle, or a chuck used for holding a drill up to ½ in. in size. The position of the tailstock of the lathe is adjustable, and work 12 in. long and 4 in. in diameter can be handled. A tool-holder is provided for use when turning metal, a screw on it being used to provide a feed. For turning wood, the steadyrest shown in front of the machine and below the base is used.



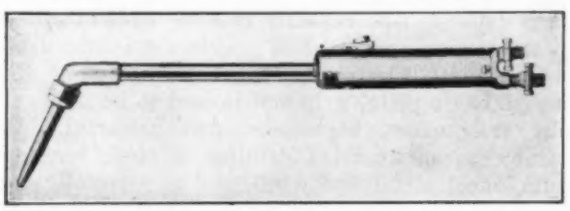
UTILITY ELECTRIC LATHE

The motor can be furnished either for 32-volt, d.c. current or 110-volt, a.c. current. Oil cups of large capacity are provided. If it is desired, it is possible to mount a buffing wheel in place of the abrasive wheel, particularly for use when polishing automobile parts. The apparatus can be furnished complete, as shown, for lathe work; but where only a grinder is required, the motor with an abrasive wheel and toolrest can be supplied.

"Cut-Weld" Type-J Oxy-Acetylene Torch

The illustration shows the type of oxy-acetylene torch recently placed on the market by the Alexander Milburn Co., 1420 West Baltimore St., Baltimore, Md. The maker states that the particular features of the torch are incorporated in the design of the tip, which is so constructed as to give a triplicate means of mixing the oxygen and acetylene.

As each gas enters the tip, it passes through a number of small jets, and each jet from the oxygen merges with one carrying the acetylene. The small jets carrying this mixture converge into a conical expansion chamber. The gases then pass through a single tube and come to the flame end of the tip. It is claimed that the mixing is so perfect that no part of the gas is unconsumed, and that the metal is not oxidized or carbonized in making the weld. The structure of the tip is said to prevent the flame from flashing back, which saves time on the part of the operator. It is necessary that the pressure of each gas be maintained at about the same degree, so that there is no syphoning effect on either gas.



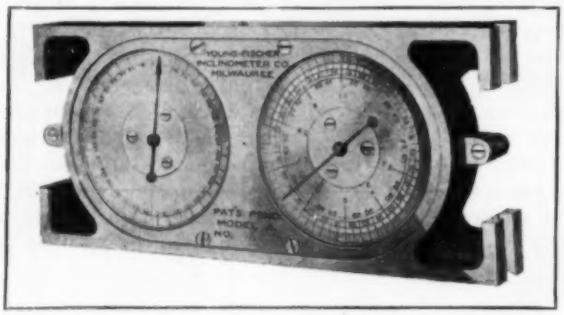
"CUT-WELD" TYPE-J OXY-ACETYLENE TORCH

It is claimed that the method of seating the tip in the torch head prevents leakage of the gas, and also of splitting and cracking of the tip and head. The torch is ordinarily made in three sizes, the 20-in. size for general repair work, the 14-in. for bench work, and the 10-in. size for manufacturing work. Each torch is provided with five tips to suit various types of work. Larger torches can be furnished, if desired, for special work. The tip for the type-J torch is made in ten sizes, No. 1 being for 16-gage metal and No. 10 being intended for use on metal 1 in. or more in thickness.

The torch is made of brass and all parts are accessible. The tip, placed at an angle of 60 deg. to the torch, is made of a piece of special bronze having a high percentage of copper. The change from welding to cutting can be quickly made by merely changing the tip.

Young-Fischer Inclinometer

The Young-Fisher Co., Milwaukee, Wis., has developed an instrument known as the inclinometer, which is shown in the illustration. This instrument is intended to take the place of the plumb, level, or protractor

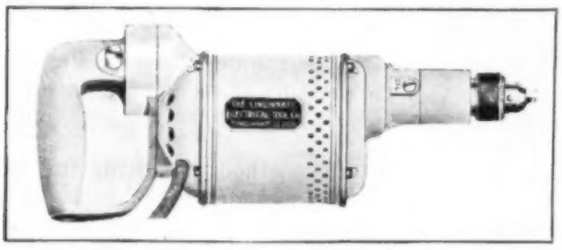


YOUNG-FISCHER INCLINOMETER

in mechanical laboratories and machine shops where angles are to be determined, and especially where extreme accuracy is required. The inclinometer consists of a machined case of cast metal containing a gear train driven by gravity impulse. The hand on the degree dial moves in unison with the impulse, while the hand of the minute dial is driven by the multiplying gear train, causing the minute hand to make 36 revolutions while the degree hand is making one. It is said that this instrument indicates directly, not only the vertical and horizontal, but any angle as well. For the accurate inspection of angles it is claimed to be superior to the sine-bar, as no calculations are necessary.

Cincinnati Portable Electric Drill

The illustration shows a light-weight, hand-portable electric drill of ¼-in. capacity recently added to the line of portable electric drills and grinders manufactured by the Cincinnati Electrical Tool Co., Cincinnati, Ohio. The drill has a pistol grip and is said to be light, practically frictionless, high-speed and powerful. It is adaptable to all kinds of drilling in steel, brass, aluminum, sheet metal and wood, and is especially useful



CINCINNATI PORTABLE ELECTRIC DRILL

for work on automobile bodies, car building and window frames.

Simplicity of construction, compactness and strength are claimed for the drill. It is equipped with a universal motor, for use on direct and alternating current of the same voltage. The motor housing, end caps and handle are made of aluminum, to reduce the weight. The armature and gear studs are mounted on ball bearings. Steel gears are used. The switch is of the quick make-and-break type, with a 50-per cent overload allowance. It is entirely enclosed in the handle and is operated by a button conveniently located on the handle.

A New, Light Metal

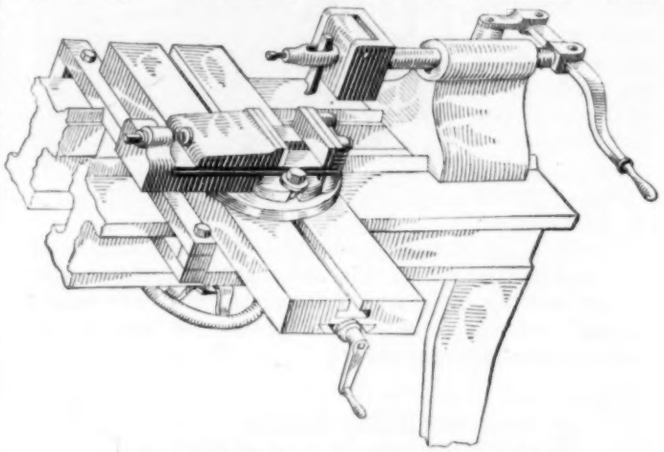
The Magna Metal Corporation, 227-229 High St., Newark, N. J., announces a new metal for various mechanical purposes where strength and lightness are essential features. The base is metallic magnesium which forms over 90 per cent of the alloy known as "Magna Metal." It can be used as castings and forgings, or it can be rolled into any shape desired. The specific gravity is given as 1.742 and the weight per cubic foot as 108.8 pounds.

Tests show the tensile strength to be 19,300 lb. for castings; 27,600 lb. for rolled; and 31,900 lb. for forgings, making a forged piece about the same strength as good gray iron. The metal can be machined very easily without lubricant and leaves a clean cut surface in threading and similar operations.

A Lathe Shaping Attachment

BY CHARLES H. WILLEY

In the shop of J. E. Gage, an old-time expert lock and gunsmith, located in Concord, New Hampshire, I found a very interesting attachment that he had made many years ago. I have tried to sketch it so that the readers



AN IMPROVISED SHAPING ATTACHMENT

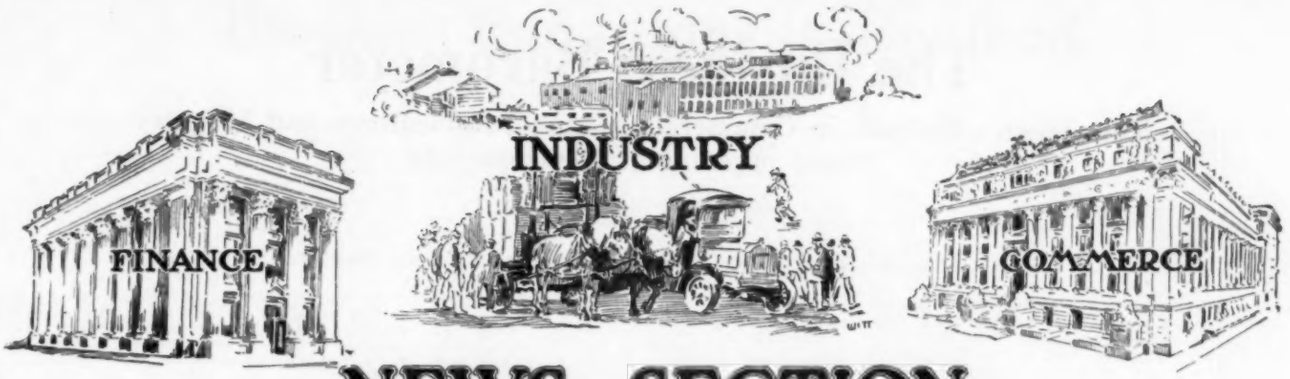
may see how this mechanic built an excellent device that enabled him to do all his shaping of slots in key blanks and other small work that comes to the shop of a lock and gunsmith.

The lathe bed was a long one so that there was plenty of room to put on an extra tailstock which was fitted up to make the shaper ram. The ram, or spindle, has a keyway on its under side; the toolpost and clapper are secured to it by studs.

The cross-slide and vise were made for a milling attachment for use at the headstock end of the lathe, and can be so used. There is a vertical slide in between the shears of the lathe bed, which is operated by the handwheel underneath.

Art Tool Co. Base Block for Height Gage

In the description, published on page 410 of the *American Machinist*, of the base block intended for holding a vernier height gage and made by the Art Tool Co., Bridgeport, Conn., it is not stated that the device is made in two sizes, one to accommodate caliper blades 0.125 in., and the other 0.140 in. in thickness. Two taper-bodied screws, adjusted on the bottom of the base by a screwdriver, grip the jaw of the vernier caliper and also pull it against the bottom of the slot.



NEWS SECTION

G. B. Bell Heads Implement Division of Commerce

George B. Bell, of Jamaica, N. Y., has been appointed chief of the Agricultural Implements and Vehicles Division of the Bureau of Foreign and Domestic Commerce. This is one of the new commodity divisions established in the Department of Commerce under the authority granted by the export industries appropriation act.

Mr. Bell has had wide experience in the agricultural implement field. He was with B. F. Avery & Sons, of Louisville, Ky., engaged in export work for 20 years, and was later director of foreign sales with Bateman & Co., of New Jersey. He has traveled in many sections of the world building up markets for American agricultural implements and has had experience in this country in manufacturing, traffic, field demonstration, advertising and sales, etc. He is familiar with all types of implements and vehicles and it is felt that the acquisition of his expert knowledge and experience will greatly aid the Department in expanding the sale of American agricultural implements in foreign countries.

New York Man to Aid Hays in P. O. Department

Postmaster General Hays announced on Sept. 15 the appointment of Ralph H. Matthiessen, president of the Motor Haulage Co. of New York City, as a special assistant of the Postmaster General to reorganize the motor transportation.

Mr. Matthiessen was selected because of his experience in the motor transport business, and because of the success he has made in New York City for efficiency and economy in this work. His acquisition adds to the corps of successful business men that Mr. Hays is introducing to all branches of the Postal Service.

Mr. Matthiessen, during his service to the Government will organize a Bureau of Motor Vehicle Transportation in the department of the Fourth Assistant Postmaster General. There are now 271 cities in which government-owned motor vehicles are operated, maintaining over 3,600 motor vehicles. Its operating expenses annually amount to about $15,000,000. There are nearly 5,000 supervisory officials, clerks, chauffeurs, mechanics, etc., employed in this class of service. There are used for these trucks about 25,000 tires each year.

The Post Office Department began operating its own machines on a small scale with the establishment of the Parcel Post. Its great expansion has been made possible through the large number of motor trucks received from the War Department.

Postmaster General Hays believes that the motor truck service of the Post Office Department should be a big mail transportation aid just as is the Railway Mail Service, and as efficiently managed.

Mr. Matthiessen will organize a force of expert field men taken from cities where the service is best managed and endeavor to build up the weak points. There will be expert mechanics and garage men picked to organize the repair work, and the operation of garages now a part of the motor vehicle service. There will be men picked for their traffic experience because street congestion is a factor in the operation of any motor vehicle in large cities. The postal management is determined to know what this, and all other branches of the service is costing. Statisticians for that purpose will be selected from cities where the best cost keeping methods are used.

Secretary of the Navy Approves Wage Reductions Recommended by Navy Wage Board

The Navy Wage Board after exhaustive hearings has recommended, and the Secretary of the Navy has approved sweeping changes in the schedule of wages for employees in the mechanical service of the navy.

Machine shop superintendents are to receive $5,000 per year. Mechanical aids are to receive from $9.40 to $8.32 per day. Mechanical inspectors are to receive from $8.32 to $5.68 per day. Mechanical instructors in the technical service are to receive $6.96 a day while their assistants will receive $6.16. Mechanical laboratorians are to receive $5.36 and $4.88 per day. Special mechanics are to receive pay ranging from $8.72 a day to $5.68 per day.

Hourly wage rates of employees more particularly concerned with machine shop work are now as follows: Machinist helpers 48 cents; laborers from 31 cents in the Southern districts to 41 cents in the North Atlantic, Great Lakes and West Coast districts; blacksmiths 73 cents to 85 cents; die sinkers 83 cents; press drillers 57 cents; drop forgers 73 cents; heavy forgers $1.31; foundry chippers 52 cents; furnace men 57 to 69 cents; instrument makers 78 cents; machine operators 56 cents; machinists 73 cents; molders 78 cents; armour plate pressmen $1.01 to $1.21; punch and shear operators 57 cents; sheet metal workers 73 cents and toolmakers 78 cents.

Export Publishers To Aid Foreign Trade

The organization of an association to counteract the determined campaign being made in all parts of the world to undermine America's predominance in foreign markets was announced last week by Edwin C. Johnston, publisher of the *American Exporter*. The association, known as the Export Publishers' Association, comprises twelve of the leading publications in English and in foreign languages, having a world-wide circulation of approximately 400,000 copies monthly.

The combined facilities of the information and research departments of all of the publications are to be used to obtain definite sales data for the use of American manufacturers, and the closest co-operation is to be effected with the Bureau of Foreign and Domestic Commerce. It is hoped, according to Mr. Johnston, to develop an organization similar in its scope to the British Board of Trade.

The organization will endeavor to work in a militant fashion to forward the cause of American foreign trade, both in this country and abroad. It will carry the gospel of American industry and will use its varied sources of information for the benefit of American manufacturers.

Edwin C. Johnston has been elected as the association's first president.

W. A. Fenn Succeeds Father as President

At a meeting of the Fenn Manufacturing Co. directors on Sept. 12 for the election of officers, necessitated by the death of W. L. Fenn, former president, W. A. Fenn, son of the former president, was elected president and treasurer. Thomas Hewes was elected vice-president and S. L. Livingston was named secretary and assistant treasurer.

National Convention of Business Men at Chicago

There will be a meeting of the National Conference of State Manufacturers' Associations at the Congress Hotel, Chicago, September 29 and 30, to consider the industrial situation, giving special attention to congressional legislation, such as the tariff (including American valuation), taxation and transportation.

The agitation as to the three subjects referred to must be settled before the country can enter upon an era of prosperity.

The convention is called at the urgent request of manufacturers generally and manufacturers' associations, with particular reference to pending legislation. Invitations are being extended to manufacturing organizations of the United States to send representatives and also to corporate and individual manufacturing firms.

A well considered program will be arranged for the two days' meeting. Every line of manufacturing business will be given an opportunity to be heard so far as is possible in the two days' session.

At the close of the convention, resolutions resulting from the deliberations will be offered for action by the convention.

William Butterworth, of Moline, Ill., is president of the conference.

Durant to Operate in Canada

William C. Durant, president of Durant Motors, Inc., has just closed a deal in which his company has taken over the plant and other property of the Leaside Engineering Co., of Canada. The Leaside munitions plant which was completed just at the close of the war, and which has never been occupied, will soon form the center of activities around which Durant Motors of Canada will be developed. Mr. Durant announced that the buildings now on the property would be utilized at once and new buildings would be constructed with a view to having the Canadian plant in production by March 1 next. Plans call for a manufacturing capacity of 100 finished cars a day.

Industrial Relations Conference

Plans for the Industrial Relations Conference to be held under the auspices of the Department of Labor and Industry on October 24 to 27, at Harrisburg, Pa., are well under way. Commissioner Connelley announced that it is likely that Vice-President Coolidge, Secretary Hoover and possibly Secretary Davis will be among the speakers at the Conference.

Exhibit at Gas Men's Convention

Optimism for the immediate future and a general revival of business activity for the industry is to be the keynote of the third annual convention and exhibition of the American Gas Association, the national organization of the manufactured gas industry in this country, which will be held in the Congress and Auditorium Hotels, Chicago, Nov. 7 to 12.

More than one hundred manufacturers will exhibit their latest gas-burning appliances and the business sessions of the convention will draw an audience of gas men estimated at 1,500.

Reports coming into the association headquarters show that when the general business situation improves there will be a tremendous jump in the demand for gas service. The industry is now making engineering and financial plans to meet this anticipated demand.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

BY THEODORE H. PRICE
Editor, *Commerce and Finance*, New York

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At some time and place which I cannot now recollect accurately, I have seen grotesque two-faced statuettes. One face was serene and smiling, but when the figure was turned an ugly leering countenance was disclosed on the other side.

I am reminded of these little statuettes by the divergent courses which business in the United States and business abroad have been taking during the past fortnight. In this country trade, industry and finance are showing a consistent, if gradual, improvement; but on the other side of the globe, especially in the countries of Central Europe, the steady decline in the values of their currencies is alarming because it is, I fear, a precursor of complete demoralization of their ability to do business.

Few persons really appreciate the near-worthlessness of these currencies. The following table shows how many dollars a thousand marks or crowns would cost at par and how much they cost today:

	Price per 1,000	
	Par	Current Rate
German mark	$238.	$9.10
Austrian crown	203	.90
Hungarian crown	203.	1.95
Polish mark	238.	.24
Czecho-Slovakian crown	203.	12.05
Jugo-Slavian crown	203.	4.00
Roumanian leu	193.	9.00

In the international exchanges, therefore, and particularly in the United States, these currencies may be said to have only a nominal value, and though the people of these countries still accept them at a much higher valuation in exchange for their goods and labor, they are kept in circulation more by the momentum of tradition than because their value justifies their existence. In fact the national currency has practically gone out of use in some districts of Poland, Austria and Hungary, being replaced by village tokens which are merely instruments of neighborhood barter.

That these peoples, even the Germans, will soon realize the relative worthlessness of their currencies seems to me inevitable. When this happens paper money will be demonetized and they will be without a circulating medium except as gold and silver may be attracted to them. Whether the governments will recognize these conditions by formally declaring a moratorium or the demonetization of paper money does not make much difference.

Of course, countries in which the circulating medium is so discredited that it will not be accepted in exchange for real property, cannot do much business and must suffer accordingly, financially and otherwise. The Polish cabinet has already fallen because of its inability to finance the government save by running the printing presses overtime, and a military dictatorship may result.

To the world at large the most important outcome of the currency debacle will be the delay in the rehabilitation of Germany and the impairment of her ability to make reparations payments. Unless she is given reasonable opportunity to trade with the rest of the world it is idle to expect her to pay the damages assessed against her. The depreciation of the mark is a bar to her imports and the tariff walls and the trade obstructions raised against her block her exports as effectively. Without money she will be helpless in international trade, and all indicators seem to herald a financial debacle.

The fear of German competition, therefore, which has taken hold of many exporters, now seems particularly ill-founded. Contracts made are not the equivalent of goods delivered. As Germany's credit disappears and the internal value of the mark declines, the productive efficiency of the nation is correspondingly decreased in many ways. Reports of faulty manufacture and oversold markets are frequent, and the prices of several iron and steel products have advanced 50 per cent in the past two months, according to a dispatch from Frankfort-am-Main.

There are other signs that the "menace" of German competition is unquestionably less than has been advertised, while opportunity for American financial penetration into Germany was never greater. The American Woolen Co., with a foresight which should help both German and American trade, has taken an option on the output of thirty-five German textile mills, and plans to sell the product in Europe and Central America.

As foreign finances grow more parlous the approaching Disarmament Conference assumes increasing importance. If the world's expenditure for armament can be cut in half by international agreement currency inflation will be reduced, the burden of taxation will be lightened and funds released which will stimulate productive activity to an extent which markets will quickly reflect. I believe business men are beginning to anticipate this more affirmatively and that their expectation has been influential in strengthening the feeling of optimism so noticeable in the past fortnight.

Aside from the currency demoralization the foreign news contains both favorable and unfavorable items. The door to Anglo-Irish comity has been closed again by the insistence of De Valera that Ireland is already what a compromising conference might have made it—a virtually independent state. It has not been locked, however, and the strength of the English markets in the face of the depressing outlook is reassuring. Another sore spot in Mexico, our equivalent of the Irish problem, is likely to be removed by the action of an international banking pool in sending Thomas W. Lamont to Mexico, presumably to plan the funding of the defaulted Mexican debt. Trade prospects are improving in many countries where deflation set in early, and our foreign trade during August showed exports of $54,000,000 and imports of $17,000,000 above the July totals.

	End of Last Week	End of Previous Week	Last Year
Bank Clearings (Bradstreets):			
In thousands	$6,126,234	$4,96/,471	$8,307,313
Business failures	334	306	144
Security prices, N. Y. Stock Exchange:			
20 Industrials	70.68	70.58	88.63
20 Railroads	73.28	73.00	79.01
40 Bonds	79.10	78.73	75.42
Commodity prices:			
Wheat, No. 1 spring	$1.75	$1.71	$2.82
Corn, No. 2, yellow	.72	.74	1.55
Beef, good dressed steers	15.25	15.75	24.50
Pork, mess, bbl.	25.00	25.00	31.00
Sugar, refined	.0560	.0560	.1450
Coffee, Rio No. 7	.07⅞	.07¼	.07¾
Cotton, middling	.1970	.2110	.3100
Print cloths	.06	.06	.10¼
Wool, domestic average	.4000	.4000	.....
Silk, No. 1, Sinshiu	5.80	5.65	6.70
Rubber, crude, plan	.1425	.1425	.2350
Hides, pack. No. 1	.14	.17	.28
Iron, No. 2, Phila	20.34	20.34	55.00
Steel billets	30.00	30.00	60.00

In the United States praise of the boll weevil is heard up and down the markets. Cotton has fallen from the high point reached in its sudden upturn, but has clung to a slightly lower level with a tenacity which I, for one, scarcely expected. Its recovery has started rolling a ball of industrial improvement which should gather size and momentum as it goes.

Appreciation of this and other favorable factors has injected into business a more confident feeling than has been felt in months. The stock market, despite the weakened technical position which results from a wave of short covering, has settled back but little. Grains, despite a lapse in export demand, are steady. Copper, hides, wool and most other commodities are also firm, and in iron and steel, most depressed of industries, two important price advances have been recorded in a week. These are the first since the decline started, and in conjunction with statistics showing increased production during August they may be interpreted as proof that July was the bottom of the downward swing and that this great laggard in deflation is now definitely recovering.

Furs, a "luxury," have been bought briskly at advanced prices in the Montreal auction. Detroit and Toledo are taking on new hands in automobile plants. Railway traffic is still increasing. In retail trade the significant feature in all reports is that stocks are at the irreducible minimum, and that though dealers are buying only from hand to mouth a more complete replenishment will soon be inevitable.

Virtually all other barometric signs are favorable. The liquidation of agricultural loans has proceeded smoothly, following the heavy movement of farm products to market, and as gold imports are still pouring in, easier money is in sight. The Federal Reserve statement shows a further gain in the reserve ratio from 66.2 per cent to 67.7 per cent, and a gain in gold holdings of $28,000,000. New issues of bonds and notes are being put out in increasing volume and are generally oversubscribed. The government issue of $600,000,000 in short term notes, despite the lowered rates of interest, has been greeted by the largest oversubscription on record.

This sufficiency of capital is one of the surest signs that our domestic business is fundamentally healthier. It is marching ahead as fast as the confidence of its leaders will permit. Whether it will be slowed up by the distress which will follow the precipitate deflation in store for Central Europe I do not venture to predict, but it is evident that is the quarter of the world on which our eyes should be most closely fixed.

American Trade Bureau in South America

Colonel S. Graae widely known in South America and Europe as a civil engineer, sailed from New York for Buenos Aires on Aug. 25 to perfect the organization of the new American Trade Bureau which he has established. This Bureau's field includes Argentina, Uruguay, Paraguay and Bolivia and its main headquarters will be in Buenos Aires. Colonel Graae also will represent some of the enterprises of E. F. Korbel and Worth Colwell, of New York, in South America. These include several large industrial expositions in various cities.

Colonel Graae will have headquarters at the Plaza, Buenos Aires.

Stocks of Iron in Japan

In view of the fact that there are large stocks of iron in Japan, the Government Iron Works supplies amounting to 196,225 tons, it is reported that no more iron will be imported for the rest of the current year.

Business Conditions in England

By Our London Correspondent

The general tone of the industrial world seems more cheerful, though justification for it in the form of new orders received will not easily be found. In engineering production costs will probably be lessened shortly by the removal of the Churchill bonus of 12½ per cent on time rates, etc., for though there will doubtless be discussion—a conference has in fact been called for the end of September—it is pretty generally thought that this reduction in wages will be made without an undue amount of friction. The coal position is beginning to lead to some questionings on the part of miners' leaders, for supply outstrips demand, though in a broad sense prices have been reduced. But the ring or federation of retailers, at any rate in the London district, have determined to do their best to keep up the price for household qualities, with the result that an unorganized but very general strike of consumers is in operation. Few people are ordering, at any rate while the days and evenings remain fairly warm. The weather has had a marked effect on the position of the miners. Some dealers have undertaken to compensate customers for any reduction in retail prices between now and Christmas. According to present signs, the miners will find that when the 10-million-pound government subsidy is exhausted the wages reduction will remove all the gains obtained through recent legislation.

Wages are being reduced all round and now at the beginning of the month civil servants, major and minor, to the number of something like 300,000, and more than half that number of workpeople employed by municipal authorities, will find their salaries and wages automatically decreased as the result of the decline in official cost of living figures. The estimated saving on civil service costs is about 10 million pounds per annum. Other classes to experience a fall in wages are building trades workers, dock workers, flour mill workers, gas workers, agricultural workers, etc., but the printing trades workpeople have by a majority decided against accepting reduction and trouble is possible at the end of September.

Mine Operation Resumed

The main features in the improved labor world is the resumption of work by the miners, and a steady decline has been shown for several weeks in the number of people reported as unemployed. The latest official figures available put the number at 1,575,800 and on short time 444,400, some 150,000 being registered as out of work at the London labor exchanges. The apparent improvement in the general position is in part due to the exhaustion of out-of-work benefit and, further, many persons do not register. In certain of the London boroughs the unemployed are organizing, throwing themselves in a body on the guardians of the poor with a view to greatly increasing relief provided. In two of these boroughs a man and his wife will from now on get 12s. 6d. a week each, plus 5s. for each child, and rent up to 15s. a week, with a coal allowance of 3s. 6d. It has been necessary to sentence men to imprisonment with hard labor for refusal to work in return for workhouse accommodation. The prospect for the winter is not altogether encouraging.

In shipbuilding, with the termination of the joiners' strike, more men have been employed, to complete work in hand, but few fresh orders are reported, and Yarrow & Co., Ltd., some time ago gave definite notice of its intention to close its yard at Scotstoun, on the Clyde, on account of excessive cost of production and difficulties in guaranteeing delivery. A case has been instanced of a tender for a ship at £25,000, the lowest British quotation, but actually £6,000 more than a Dutch offer. This is of course not the first time that Yarrows has closed a yard. The company removed from Poplar, London, E., several years ago to the Scotstoun works in much the same circumstances, and several months ago the announcement was made that the firm would probably diminish its production in Scotland, while increasing the work in Vancouver.

Builders of locomotives appear to be quieter, but as regards automobiles, several of the smaller makers of the lighter cars have had a fair season. The Morris-Oxford people, with an output of 160 a week, have been unable to satisfy all demands, while one or two firms which had closed down temporarily have re-opened. For the most part however the spurt seems to have spent itself and Coventry is not hopeful of export trade. The report of the Vulcan Motor Co., Southport, for the 15 months ending with last December is not particularly encouraging, a loss of £434,260 being shown. It will be remembered that Harper Bean, Ltd., bought about 75 per cent of the Vulcan shares, the capital of which was raised at the middle of last year from £150,000 to £620,000. Dividends paid have ranged from 5 to 10 per cent, free from tax, and while the business was under government control bonuses of 20 per cent net were also paid. The Singer Co. of Coventry this year paid 10 per cent which, taking into account the distribution of bonus shares last year, really represents 20 per cent on the capital that was invested.

Machine Tools Quiet

The machine-tool position cannot be described as any easier; the only business that appears to be passing is in connection with heavier tools. In fact, one firm of merchants has described this branch of engineering as a forgotten industry. Ready cash is so scarce that they would be willing to sell tools at a discount of 25 per cent for a sight of the money. Departing from their settled policy of devoting attention to a few well-known types of tools, Alfred Herbert, Ltd., since the armistice has steadily branched out, beginning perhaps with radial and other drilling machines, and passing through hardness testers to the latest arrival in the form of ordinary screwing machines with one or two additional features like the Coventry diehead.

Market reports of the iron and steel trade are still discouraging. While London notes that the amount of business effected this week was negligible, Manchester states that little of any interest has been going on; in particular the need for reduced fuel and labor costs is indicated. Although the tendency may be towards reduction of difference between British and Continental prices by the lowering of home charges and the hardening of Continental prices, a considerable gap still remains. For instance, a difference in price of £5 a ton shows between British and German ship plates, while French plates are still cheaper. The Ebb Vale Co., after six months closure, is re-starting the whole of its iron and steel plant, and some 8,000 workpeople will, it is anticipated, be engaged by October. Generally speaking blast furnaces in operation show a steady if slow increase in number (a battery of five furnaces in Wolverhampton owned by the Hickman firm will probably be in full operation in the course of two months) and Scottish steel makers similarly mention a slow, steady improvement. Middlesbrough reports that the Cleveland pig iron trade is idle, without sign of revival at present rates, the high prices of fuel again being noted. Generally, makers do not expect anything like normal conditions before October and the need for cheaper furnace coke is pressed. As to pig iron, a Northampton trader has suggested that a loss of nearly 40s. a ton would be involved if prices offered were accepted.

Sheffield Sees No Optimism

Interviews with heads of Sheffield steel firms hardly suggest optimism. W. Clark, managing director of Vickers, Ltd., has said that any improvement in trade is very slight, while reduction in wages and cost of material are insufficient to permit competition with foreign firms. T. H. Firth, of the Brightside Co., also said that the drop in wages and cost of materials has not been sufficient and that workpeople must give a greater output; he added emphatically that, as regards foundries and rolling mills, there has been no revival. T. G. Mander, secretary of the local engineering employers' association, asserted that no authoritative person could say there was any indication of trade revival in the Sheffield district. While rolling mill proprietors have reduced charges by 7½ per cent and forgers and tilters by 10 per cent, prices still remain well above those of foreign competitors.

Based frankly on the New York example, the London Engineers' Club was opened on Sept. 1 in Coventry St., between Piccadilly and Leicester Square. The accommodation includes 76 bedrooms, and the membership is at present 2,700.

Brazil a Good Market for American Motor Cars

Commercial Attaché W. L. Schurz, Rio de Janeiro

The principal factors governing the market for motor vehicles in Brazil in normal times are the small purchasing power of the average citizen, the lack of good roads, the large number of old European cars still in use (especially in taxi service), the high cost of gasoline, and the high cost of upkeep. The latter is due largely to the lack of mechanical skill on the part of most Brazilian chauffeurs.

Foreign Imitation of American Cars

There is no question of the superiority of appearance and mechanism of American cars. Their lines are more attractive and the cars are easier to run than European cars, but the European producers are rapidly approximating the designs of American models. A few attractive British closed cars have been noted lately, and some of the new Italian models show clear signs of imitation of American models. Particularly is this true of the new shipments of Fiats and Lancias received recently. The Italians, moreover, are producing a good engine for automobile use. On the other hand, the American prices are lower than those of European competitors. A local Brazilian company which sells an American seven-passenger touring car at 22,000 milreis also sells a French car of the same general grade for 40,000 milreis. The Benz and Mercedes, German cars, are now selling in Rio de Janeiro at 35,000 milreis.

American Cars Favored

Native trade is generally well satisfied with the results given by American cars and has been especially attracted by the service-station feature offered by Americans. American representation in the automobile market is usually well handled, particularly in Sao Paulo and Rio de Janeiro, which cities take most of the cars imported. Sao Paulo is rapidly becoming the foremost field for automobile sales, due to the expansion of the State road system and its prosperity and progressiveness in normal times. The money put into circulation by the valorization of coffee makes Sao Paulo at present the only real market for motor vehicles in Brazil, sales having almost stopped in Rio de Janeiro in spite of the advantageous prices offered. Considering the exchange relations between the two currencies, American cars are now being offered at prices considerably lower than the price at which they can be obtained in the United States, and one American company is now proposing to sell on the basis of 5 milreis to the dollar, on the assumption that exchange will return to that figure within at least a year.

Sales Methods in Practice

The common terms of sale to purchasers of known responsibility are one-half down and the remainder in six months. Most German cars are shipped to Brazil on consignment, the custom being formerly for the Germans to sell cars to taxi chauffeurs at 1,000 milreis down, and the remainder in long-time payments, secured by the chauffeur's note to the German bank which financed such transactions. German competition in this line, however, is not of such serious concern for the present, but Italian and French competition is becoming very active, and some of these foreign cars still have considerable prestige in the market.

[A list of importers and dealers in motor cars and accessories in Brazil may be obtained from the Bureau of Foreign and Domestic Commerce or any of its district or cooperative offices by referring to File No. K. A.-12023.]

New Iron Works in Osaka, Japan

The recent organization of the Niniwa Iron Works and the Tanaka Iron Works in Osaka, Japan, the latter capitalized at 100,000 yen, to manufacture machinery and boilers is announced in the *Far Eastern Review*. It is also stated that the Aki Shoji Co., with a capital of 200,000 yen, has been formed in Osaka for the sale of iron, pig iron, and steel.

Ohio Manufacturers To Meet at Cincinnati

Through the efforts of John E. Edgerton of Nashville, president of the National Association of Manufacturers, a general meeting of Ohio manufacturers has been called to be held at the Hotel Sinton, Cincinnati, on Oct. 14. J. Wallace Carrell, David C. Jones, W. S. Stearns, J. W. Strobridge, Lucien Wulsin, Walter Friedlander and Milton Adler have been named a committee to arrange details of the meeting.

The meeting was arranged to bring together manufacturers to discuss national problems, such as the merchant marine, transportation, tariff, waterways, taxation and labor relations and to devise methods for their solution. State meetings of manufacturers probably will be followed by one of manufacturers of the entire country in an effort to get together on a common platform, it was said.

Atlanta Has New Welding Plant

The Bird-Potts Co., of Atlanta, Ga., have opened in that city a completely equipped plant devoted exclusively to the welding of metals. It is located at 376 Marietta St., and provides 12,500 sq.ft. of floor space. An investment of nearly $75,000 is represented.

There are four electric welding machines, oxy-acetylene welding machines, traveling cranes of 10-ton capacity, and all other machinery necessary for welding of any metal article of from 1 lb. weight to 10-ton weight. George Bird, senior member of the company, is a pioneer in the industry in the South, organizing and operating the first welding plant south of the Mason and Dixon line about fifteen years ago. During the war he was a member of the welding committee of the Emergency Fleet Corporation.

Buenos Aires Wants Oil-Well Supplies

It is suggested that manufacturers of oil-well supplies, accessories and tools, including drilling outfits, send catalogs to the Bureau of Foreign and Domestic Commerce, Washington, D. C., for transmission to the American Embassy in Buenos Aires, one copy for delivery to the Direccion General de Petroleo, the other to be retained in the office of the commercial attaché. There has been one inquiry for twelve pipe-cutting machines of various sizes, and Commercial Attaché Edward F. Feely states that all indications point to a greatly increased interest in the petroleum industry, with a consequent large demand for oil-well supplies and equipment.

Wages in the German Automobile Trades

Assistant Trade Commissioner W. T. Daugherty, Berlin

A strike for higher wages in the German automobile building trades in February and March, 1921, resulted in pay increases for both unskilled and skilled workmen.

The following wage schedule, furnished by the Schebera Aktein Gesellschaft, motor car body builders of Berlin-Tempelhof, presents, for practical purposes, the approximate current wages being paid in the automobile building trades. Unskilled labor in 1913 received 20 pfennigs per hour; before the strike it received 5 marks per hour, and now (July, 1921) it receives 6.40 marks per hour. The apprentice class of labor received in 1913 but 25 pfennigs per hour; before the strike 6 marks, and now 6.80 marks per hour.

The skilled workman before the war, 30 pfennigs per hour; before the strike, 7 marks per hour, and now, 7.80 marks per hour, with the provision that in piecework he may earn up to 10 marks per hour but no more. The first-class workman, "Vorarbeiter," receives between 8 and 9 marks an hour, while the foreman, or so-called "Meister," gets but 8 marks an hour.

Market for Drilling Machinery in Czechoslovakia

Trade Commissioner Donald L. Breed has reported that there is very little chance for the sale of American drilling machines in Czechoslovakia at present. This condition is due both to the unfavorable condition of exchange and to the fact that the domestic makers of similar machinery are now heavily overstocked and find it next to impossible to dispose of their goods. How long this condition may continue is not known, but a change is not to be expected within the near future.

Gilbreth Presents Further Indictment of Stop-Watch Time Study

At a well-attended meeting of the Taylor Society held on Thursday evening Sept. 15 in the Flatiron Building Restaurant, New York City, Frank B. Gilbreth, consulting engineer and internationally known authority on motion and fatigue study, presented what he styled "a further indictment of stop-watch time study." Mr. Gilbreth's paper was entitled "Micro-Motion Study for Current Use," and its preparation and presentation was the outcome of a controversy which had its beginning in December, 1920, when Mr. Gilbreth, assisted by Mrs. Gilbreth, gave a paper before the New York Section of the Taylor Society. This paper, entitled "Time and Motion-Study, Its Fundamental Factors in Planning and Control: and Indictment of Stop-Watch Time Study," caused considerable comment among management engineers, and others. In April of this year criticisms of the Gilbreths were answered by various Taylor Society engineers in a meeting of the Philadelphia Section. As a consequence the editor of the Taylor Society bulletin asked the Gilbreths for "more data-descriptions of cases and figures contrasting micro-motion and stop-watch results." At the meeting on Sept. 15 Mr. Gilbreth presented this data.

The definite point on which the whole issue depended seemed to be whether stop-watch technique is so "unscientific" as to be unsuitable for the determination of standard times and standard rates as a basis for current wage contracts. Mr. Gilbreth stated that the proponents of the stop-watch concede the complete superiority of the micro-motion method for everything, except finding "standard times and standard rates for current use." He added that the stop watch method is now fighting for an excuse for living, and is, so far as permanent value is concerned, a complete surrender to the micro-motion method of securing times. The speaker backed up his remarks with references and quotations from accepted technical data, and went on to prove his theories with a motion-picture camera which was equipped with a clock, the dial of which is graduated into hundreths, the hand making a complete revolution in exactly one minute.

Following Mr. Gilbreth's address there was an open discussion. Several of those present, among them some well-known engineers, aided in bringing out further information on the subject. It is expected that further meetings, at which this subject will be argued pro and con, will come as the result of Mr. Gilbreth's latest indictment.

H. S. Peck Now President of Industrial Cost Association

At a meeting of the board of directors of the Industrial Cost Association held on Sept. 8, at Pittsburgh, Pa., the resignation of J. W. Stannard as president and director was accepted. Horace S. Peck, comptroller, S. K. F. Industries, Inc., New York City, was elected to fill the vacancy. Messrs. Christopher Haigh of the General Electric Co., West Lynn, Mass., Joseph P. McLean of the Pittsburgh Forge and Iron Co., Pittsburgh, and Ernest J. Wesson of the W. T. Raleigh Co., Freeport, Ill., were elected directors.

It was decided to hold the fall conference at Pittsburgh, Nov. 2, 3 and 4. Full details and the program of this conference will be announced later.

Demand for Mild Steel Plates in British Malaya

There is a considerable call from the tin mines of British Malaya for mild steel plates of 8 x 4 ft. in $\frac{3}{32}$, $\frac{1}{16}$, $\frac{5}{32}$, and $\frac{1}{4}$ in., reports Trade Commissioner John A. Fowler. Recently Belgian mills quoted prices, successfully competing with the British mills.

McClintock Appointed Commerce Adviser

Dr. Samuel McClintock of Chicago, Ill., has been chosen by Secretary Hoover as editorial adviser of the new commodity divisions of the Bureau of Foreign and Domestic Commerce. Investigations of importance to the major industries of the country will be made under Dr. McClintock's direction. Dr. McClintock was formerly American Consul in Latin-America. He comes to the department from New York, where he was editorial director of the McGraw-Hill Book Co. He is also known as a lecturer in applied economics at the College of the City of New York.

Business Awakening Throughout Southern States

Industrial conditions continue on the upward trend throughout the South. A general survey of the employment situation based on actual count in the six most important industrial centers shows an increase of 6 per cent in Chattanooga during August, as compared with July; 5.2 per cent in Birmingham; 5 per cent in Memphis; and 1.5 per cent in Richmond. In Atlanta a decrease of 8.27 per cent is shown during August, with a decrease in New Orleans of 1.6 per cent.

In Florida a state-wide shortage of labor is indicated by the survey, with practically no unemployment.

As a whole the survey indicates industrial improvement with a promise of even greater improvement by the end of the year.

In Georgia, Florida, South and North Carolina and Virginia, this territory being known as the South Atlantic district, considerable improvement is shown in textile mill conditions, with slight improvement in lumber. Gratifying increases are also shown in railroad occupations.

In Tennessee, Alabama and Mississippi, this section being known as the East South-Central district, considerable improvement also is shown in railroad and textile mill employment, with some improvement in lumber. Demand for coal is far below normal and coal mining operations in the district are not encouraging. Building is more or less active in spots. This district shows much greater improvement among the metal trades industries than the South Atlantic district. August noted an increase in operations among many of the plants in Alabama, which is the largest iron and steel section in the South, and there is promise of considerable improvement during the next few months. In fact, most of the iron and steel and kindred plants in Alabama are preparing to gradually increase operations.

Demand for Machinery

Another indication of improvement in industrial conditions over the South is the steady increase in the demand for machinery, mill and machinery supplies, reported by manufacturers and distributors in Atlanta. Atlanta is the largest distributing point in the South for mill and machinery supplies and the demand for these lines is always an accurate barometer of industrial conditions over the South. At present most of this demand is among textile plants, lumber mills and cotton oil mills, while an increase also was noted during August for machinery and supplies among the metal trades industries. The outlook is encouraging for a return to normal in this line by the end of the year.

Pig iron production gives promise of still further improvement after Oct. 1, because of an approximate reduction of 30 per cent on raw materials to the furnaces. Coal, coke, iron ore and limestone are affected by the rate reduction which was ordered by the Alabama Public Service Commission. This is interstate transportation and the case has been pending for several months. The new rates become effective Oct. 1, and as a result of this favorable decision there is a much better feeling among furnace operators in the district. It will have the affect of increasing or improving conditions among virtually all of the metal trades industries.

The stiffening of high-pressure cast-iron pipe prices is having a favorable effect on the pipe making industry in Alabama, most of the larger plants reporting increased operations the past few weeks. The National Cast Iron Pipe Co., at Tarrant City, Ala., one of the largest pipe plants in the state, is operating at 100 per cent capacity. The stiffeneing of the prices is of considerable importance in Birmingham, for that city is the largest manufacturer of high-pressure cast-iron pipe in the country.

All lines of commerce and industry throughout the South, in fact, are showing steady improvement, the recent tremendous boom in cotton prices being one of the primary factors contributing to this improvement.

Bosch Magneto Co., of Stuttgart, To Enter American Market

Hugo Borst, chairman of the board of the Robert Bosch Magneto Co. of Stuttgart, Germany, has left New York after a two weeks' visit spent in looking over the prospects of marketing the original German company's product in this country. It is planned to go after the American market on a large scale.

Evolution of an "American Machinist" Article—VIII

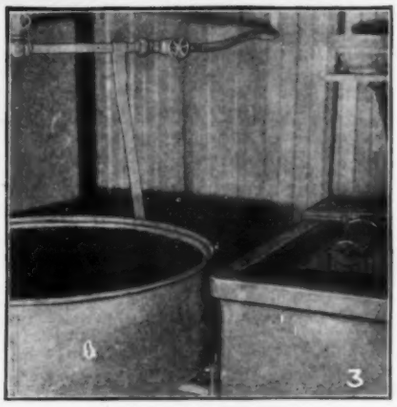
The illustrations appearing in the text columns of the *American Machinist* are photoengravings—the photographs usually being made into halftones, and drawings, charts, etc., into line cuts. The general meaning of the word photoengraving is a process by which a design, or image, is, by means of a photograph, transferred to a metal plate, which is then etched, or cut away, by chemical and mechanical means.

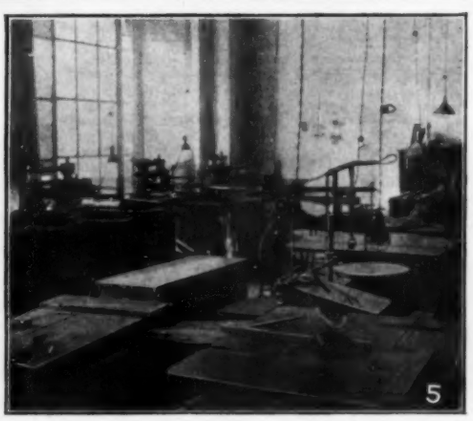
Fig. 1 shows the "camera" for making a halftone. A negative of the photo is made, the light passing through a "screen" before it falls upon the negative plate. This "halftone screen" consists of two pieces of glass ruled with parallel lines and joined together so that the lines run at right angles. A halftone screen is shown at A. The effect of the screen is to break the rays of light into separate beams on the negative thus forming the myriad of dots that you will notice in an illustration. If it were not for these dots the result would be a solid, black mass. Line cuts are produced on the negative without the use of the screen.

Fig. 2 shows the stripping process, where the film is stripped from the negatives. These strips are repasted on a large flat glass plate so that several can be used for printing on a single sensitized copper or zinc plate. This enables faster and more economical work to be accomplished. Photographs in our work are usually made into copper halftones while drawings are made into zinc plates.

Owing to the inadvisability of using a flashlight it was only possible to photograph the corner of the printing room shown in Fig. 3. Here are shown the developing tanks. The design is transferred from the glass negative to the sensitized copper, or zinc, plate in a manner similar to that by which a photographic print is made. After developing, the parts of the plate which are to remain high enough to be inked are treated with an acid-resisting chemical, after which the plate is given a preliminary acid bath in a tank such as that shown in Fig. 4. In order that the acid may not cut away parts to be inked the plate is removed from the bath, examined, recoated with the chemical if necessary, and then suspended in an inclosed tank where acid is sprayed against it. Halftone plates are etched by chloride of iron, and zinc plates by nitric acid.

Fig. 5 shows the machine room where the plates are sawed, trimmed, routed and tacked onto wooden blocks. Hand finishing is required on a great many cuts, to do which a large force of engravers are employed. When the cut is finally completed, proofs are taken. The cut is then stored, the number of the cabinet and drawer in which it is placed being marked on the proof, and the latter sent to the makeup man.





Business Items

A Southeastern branch has been opened in Atlanta by the Winchester Repeating Arms Co., one of the five branches of this kind the company maintains in various parts of the United States. Edward Lee is manager.

Fire, thought to have been of incendiary origin, recently destroyed the $500,000 plant of the Flake Graphite Corporation, at Goodwater, Ala. This is said to have been the largest plant of its kind in the United States.

The Gifford Screw Products Co., of Worcester, Mass., has been recently organized and incorporated under the laws of Massachusetts, to make screws, etc. The president is William E. Gifford, of Worcester; J. Boyd Coats, of Glenside, Pa., is the treasurer.

The B. F. Zimmerman Manufacturing Co., Inc., of New Haven, Conn., has been organized and incorporated to make tools, etc. The capital stock of the company is $150,000; the incorporators are B. F. and M. Zimmerman, and Harry A. Waldron.

The English Electric Co., of Canada, has purchased the plant and business of the Crocker-Wheeler Co., at St. Catherines, Ont. The new management will produce electrical equipment and appliances, rolling stock for railroads and tramways, and switchgear and control apparatus of all kinds. Gordon F. Perry, president of the National Iron Corporation was elected chairman of the board.

The Supple & Walker Machine Works, Portland, Oregon, has been incorporated to manufacture and sell machinery and mechanical equipment. Joseph Supple, C. T. Walker and L. E. Crouch are directors.

The Wopeco Machine Co., has been incorporated at New Haven, Conn. Capital stock $69,000. Directors are G. H. Woodruff, W. S. Perry and J. W. Commerford.

An Anglo-Chinese-Japanese syndicate has been organized with a capital stock of $15,000 to establish a large iron foundry on Shinwa Island, China, where it is planned to produce 200 tons of pig iron per day.

The Ace Motor Corporation of Philadelphia, Pa., has been sold at a receivers sale to Max M. Siadkin for $500,000.

The Waugh Foundry and Machine Works, Williamson, W. Va., announces that work has been started on the new plant of that company. It is expected that production will be started in about a month.

The Grip Tool and Machine Co., has been incorporated at Worcester, Mass., with a capital stock of $50,000 to manufacture tools and machinery. Carl G. Grip is president and John F. Hjort, treasurer.

Increase of the capital stock of the National Cash Register Co., Dayton, Ohio, from $15,000,000 to $30,000,000 has been authorized by the secretary of state. The new stock is all preferred. Expansion of business is given as the reason for the increase by company officials.

The Dayton-Wright Co., a subsidiary of the General Motors Corporation operating three plants in Dayton, Ohio, has completed the development of a five passenger, air-cooled automobile which it is arranging to place on the market. The company is also engaged in the production of airplanes, having recently obtained a $500,000 contract for building airplanes for the U. S. Government.

The Bureau of Applied Economics, Inc., has removed from 921 Fifteenth St., N. W., to its new quarters at 921 Southern Bldg., Washington, D. C.

The Springfield Motor Specialties Co. of Springfield, Mass., was recently organized and incorporated with offices at Springfield, Mass., to manufacture automobile specialties, etc. The capital stock is $110,000. The officers are Charles P. Whittall, president; Edward A. Higney, vice-president; and John G. Waddell, treasurer.

The Metal Goods Manufacturing Co., of Boston, Mass., has recently been organized and incorporated with a capital stock of $100,000, to manufacture metal goods, metal stamping, etc. Ralph C. Heath, of Boston, is president; Reginald C. Heath, of Melrose, is treasurer.

A company is being formed by J. H. Gardner, of the Colliery Investment Trust of America, Inc., New York, for the purpose of developing a reciprocal American-Irish trade. It is intended to export to Ireland coal and other products and it is hoped to obtain orders from American firms for Irish products. Agencies for American goods are desired by the company.

Kerman & Swift, factory representatives, have opened offices at 45 West 18th St., New York City. This is a newly organized partnership formed by Frank G. Kerman and Clarence M. Swift. They will handle all kinds of machine tools as agents for several prominent manufacturers.

The Liberty Machine Tool Co., Hamilton, Ontario, Canada, has built to order, two planers for the Harrisburg Foundry and Machine Co., Harrisburg, Pa.

The Paris despatches to newspapers of negotiations for the purchase of the properties of Archduke Ferdinand of Austria have been confirmed by J. Leonard Replogle, president of the Vanadium Corporation of America. The properties include the Teschen Steel Works and iron mines, employing between 20,000 and 25,000 men and now operated at about 85 per cent of capacity.

The Equalizer Roller Bearing Co., Cleveland, Ohio, has increased its capital stock to $750,000.

William Jessop & Sons, Inc., of New York, has recently opened new offices and warehouse at 112-118 North May St., Chicago, Ill. This branch is under the management of C. V. Luin.

Trade Catalogs

Small Tools. Greenfield Tap and Die Corporation, Greenfield, Mass. Catalog No. 46 covering a comprehensive line of taps, dies, screw plates, drills and reamers, milling cutters and pipe tools. Specifications and prices are also furnished.

Watson Motors. The Mechanical Appliance Co., Milwaukee, Wis. Bulletins Nos. 401, 402, 403, 404, and 405 describing several types of alternating and direct current motors, embodying many new features.

Motors and Generators. Electro Dynamic Co., Bayonne, N. J. Bulletin No. 300, describing by word and picture the process of manufacture of electric motors and generators in the company's plant at Bayonne.

Personals

Ogden R. Adams, machinery merchant of Rochester, N. Y., has been elected president and general manager of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., manufacturer of "Star" and Adams "Short-Cut" lathes. Mr. Adams still remains at the head of his Rochester business, which will not in any way be interrupted by his new connection.

E. W. Ebilhare, general superintendent of the Locomobile Company of America, with works at Bridgeport, Conn., has tendered his resignation.

G. A. Thompson and J. R. Hussey are now associated with the Brown & Zortman Machinery Co., Pittsburgh, Pa., having sold out their interest in the Thompson Machinery Co.

L. R. Samuels, formerly assistant sales manager of William Jessop & Sons, Inc., New York, has returned to that company after a year's absence. Mr. Samuels will make his headquarters in New York.

Paul Fugler, superintendent of materials of the Walworth Manufacturing Co., Boston, Mass., recently resigned his position in order to return to his home in England. Mr. Fugler was with the Walworth concern for seven years.

William Podolski, has recently been appointed superintendent of materials of the Walworth Manufacturing Co., of Boston, Mass. Mr. Podolski has been with the concern since 1905.

F. M. Travis, has recently been appointed general sales manager of the Locomobile Co., of America, Bridgeport, Conn., manufacturer of Locomobile automobiles and Riker trucks.

Robert J. Metzler, formerly treasurer of the New Jersey Machinery Exchange, has organized the R. J. Metzler Co., Inc., with offices at 15 Mechanic St., Newark, N. J. His associate is John T. Elliott, who was also an official of the exchange.

W. E. Mathews, secretary of the Carrol Foundry and Machine Tool Co., Bucyrus, Ohio, has assumed full charge of the Lambert boring mill branch of the concern.

Charles E. Hildreth of Worcester, Mass., has been appointed receiver for the Springfield Automatic Screw Machine Corporation, of Springfield, Mass.

D. D. Lewis has been appointed general manager of the Carrol Foundry and Machine Tool Co., Bucyrus, Ohio. Mr. Lewis has been identified with several manufacturing concerns including Southwark Foundry and Machine Co., Buckeye Engine Co., Cambria Steel Co., and Jones & Laughlin Co.

Daniel S. Rhodes, of Gloversville, N. Y., has been granted a patent for a machine for renewing worn-out threads of any description. Production of the machine will begin as soon as facilities are obtained.

John D. Hurley, president of the Independent Pneumatic Tool Co., Chicago, Ill., manufacturer of Thor air and electric tools, arrived in New York on the steamship "New Amsterdam" on Sept. 9, and reached the home office in Chicago, on Sept. 15. Mr. Hurley accompanied by Mrs. Hurley, has just completed a six weeks' trip abroad, visiting all the principal points of Continental Europe.

Fred W. Jacobus, superintendent of machinery at the Moore plant of the Bethlehem Shipbuilding Corporation at Elizabeth, N. J., has resigned.

Obituary

Morris T. Wright, founder and president of the M. S. Wright Co., Worcester, Mass., died on Sept. 6. He was 62 years old. He was widely known as an inventor and developer of mechanical appliances.

H. B. Busch, of Bedford, Ohio, president of the Busch Electric Co., was instantly killed on Sept. 1, while demonstrating an instrument of his own invention. The fatal accident happened in the plant of the New England Power Co., at Worcester, Mass.

Albert Hellwig, president of the Steel Heddle Manufacturing Co., of Philadelphia, Pa., was killed by an automobile at New Brunswick, N. J., on Sept. 6.

W. A. Patterson, president of the Patterson Automobile Co., of Flint, Mich., died on Sept. 9. He was 82 years old.

George H. Hall, former Senator, of Bristol, Conn., died Sept. 10 from apoplexy after an illness of two hours. Senator Hall was seventy years of age. He was for thirty-five years superintendent of the J. H. Sessions & Sons Co., hardware manufacturers of Bristol, Conn. and retired from the concern about twelve years ago.

Melville F. Goodrich, former president of the United States Motor Transportation Co., of Boston, who was stricken by pneumonia recently, died in a hospital in Omaha, Neb., on Sept. 13.

Export Opportunities,

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An American citizen located in Brazil desires to secure an agency from manufacturers for the sale of calculating machines and typewriters. Reference No. 43.

A commercial agency firm in Norway desires to purchase and secure an agency for the sale of motor cycles and accessories. Quotations should be given c.i.f Norwegian port. Reference No. 40.

A firm in New South Wales, Australia desires to purchase clothes-cleaning and general utility dyeing machinery and dry-cleaning equipment, and also laundry machinery. Quotations should be given f.o.b. New York and San Francisco. Payment to be cash against documents. Catalogues and price lists are requested. Reference No. 28.

A manufacturing company in South Africa desires to purchase grinding and crushing machinery for the manufacture of bone meal. The capacity of the entire plant is to be 2 to 5 tons per day. Prices, specifications, and full information are required as soon as possible. Reference No. 34.

An engineer in Norway desires to secure an agency for the sale of motor boats and marine engines for fishing and pleasure; motor cycles; motor tractors; and automobiles. Quotations should be given f.o.b. New York. Terms: Payment against documents in New York. Reference No. 31.

A firm of importers in Chile desires to secure an agency for the sale of automobile accessories, supplies and equipment; iron and steel, paints and varnishes; and also motor trucks on consignment. Quotations should be given f.o.b. New York, or c.i.f. Talcahuano, Chile. Reference No. 29.

The government of a country in Asia desires to purchase various types of industrial machinery, such as paper-making machinery and spinning, weaving and knitting machinery. Quotations should be given c.i.f. Karachi or Bombay, India. Catalogues and prices should be forwarded. Reference No. 21.

A manufacturing company in Natal, South Africa, desires to purchase machinery for producing plain and reinforced concrete pipes and also the most modern machinery and molds for the production of anything in concrete (excepting building blocks) which may be factory made. Reference No. 18.

A merchant in Switzerland desires to purchase machines for casting in stabs under pressure (understood to mean "die casting"). Quotations should be given c.i.f. Havre or Genoa. Correspondence should be in French. Reference No. 19.

A mercantile firm in India desires to secure an agency for the sale of hardware supplies, builders' supplies, electrical appliances and automobile accessories. Payment to be made through bank in India. Reference No. 8.

An agency is desired by a merchant in Canada for the sale of automobile accessories and hardware. Reference No. 4.

Forthcoming Meetings

The third annual convention and exhibition of the American Society for Steel Treating will be held in the Manufacturers Building, State Fair Grounds, Indianapolis, Ind., during the week of September 19 to 24 inclusive.

The annual congress of the National Safety Council will be held at Boston, Mass., during the week of September 26. C. W. Price, 168 North Michigan Ave., Chicago, Ill., is general manager.

The twelfth annual convention of the American Manufacturers Export Association will be held in the Waldorf-Astoria Hotel, New York City, on October 5 and 6. A. W. Willmann is secretary.

The fifth annual convention of the Society of Industrial Engineers will be held at Springfield, Mass., Oct. 5, 6 and 7.

A joint meeting of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Army Ordnance Association will be held at Aberdeen, Md., Friday, October 7.

The annual meeting of the National Association of Purchasing Agents will meet in the Claypool Hotel, Indianapolis, Ind., on Oct. 10 to 13, inclusive. L. F. Boffey, 19 Park Place, New York City, is secretary.

The American Gear Manufacturers Association will hold its semi-annual meeting at Rochester, N. Y., October 13, 14 and 15. F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa. is secretary.

The National Machine Tool Builders' Association will hold its fall meeting at the Hotel Astor, New York City, October 18, 19 and 20.

The third annual convention and exhibition of the American Gas Association will be held in the Congress and Auditorium Hotels, Chicago, Ill., on Nov. 7 to 12.

NEW *and* ENLARGED

Machine Tools and Machinery Wanted

Machine-tool wants published without charge

Md., Baltimore—The Machinery Clearing House Corp., Coca-Cola Bldg.—
One 16 in. x 8 ft. lathe.
One screw machine to take 2¼ in. stock.
One lathe, 18 to 20 in. swing with 8 to 10 ft. bed.
One lathe, 24 in. swing to take 6 ft. 6 in. between centers.
One Lodge & Shipley, LeBlond or American motor driven lathe.

N. J., Jersey City—The Great Atlantic & Pacific Tea Co., Bay 1st and Provost Sts.—machine tools including planers, power hammers, etc., for new motor truck body shop.

N. Y., East Aurora—F. Slade—coal hoist or elevator, Galon preferred.

N. Y., New York—J. F. Oberle, 238 West 42d St.—Buffalo forge combination slitting shear, punch and bar cutter, etc.

N. Y., New York—Reliable Iron Machine Wks., 5311 2nd Ave.—punch and shear.

Pa., Sunbury—The Butter Krust Baking Co., c/o B. Apple—mixers, conveying systems, etc.

Ga., Milltown—Lanier County Lumber Co., R. Henderson, Purch. Agt.—steam nigger, combination edger, two-saw board trimmer, log kicker and roller, (used).

La., New Orleans—The Dixie Auto Repair Shop, 1412 North Rampart St.—equipment for auto repair shop including medium size lathe (new or used).

La., New Orleans—The E. A. Dumas Co., Inc., 741 St. Charles St.—automobile repair shop equipment.

La., New Orleans—The Orleans Steel Products Co., Inc., 1021-25 Bienville St., or P. O. Box 274—One Loy & Nawrath, G. A. Ohl or equal ⅛, 7/16 or 7/32 capacity, 10 ft. 6 in. power cornice press brake, (used). One ⅛, 7/16 or ¼ capacity G. A. Ohl or Loy & Nawrath power squaring shear 10 ft. 6 in. long, belt or direct motor driven, (used). One 24 x 24, 10 ft. clear bed, late model planer, (used).

N. C., Wilmington—The Atlantic Coast Line RR., Nutt St.—truck drills.

Va., Richmond—W. Moore & Co., 17th and Dock Sts., manufacturer of fire brick sewer pipe, etc.—one 18 in. Bonnot mill, and No. 8 and No. 10 Cyclone dust collector.

Ill., Chicago—The Chicago Metal Mfg. Co., 216 West Ontario St.—one 10 ft. 6 in., 10 ga. power press or brake.

Ill., Kankakee—W. C. Burrell—one 14 in. engine lathe, one 12 in. or 14 in. screw machine and one cylinder grinder.

O., Cincinnati—Norton Broadway Mchy. Co., 236-8 Bway., W. D. Norton, Purch. Agt—one 10 in. extending to 16 ft. old style horizontal boring mill with 1 or 2 heads, one 500 lb. belted power hammer and one set of 10 to 12 in. boilermakers plate rolls, (used).

O., Columbus — The Columbus Forge & Iron Co., West 1st Ave., D. W. Singleton, Secy. and Treas. — several large steam hammers, presses and other equipment for factory.

O., Columbus—The Gem Gasoline Lock Co., Long St. and Grant Ave., O. Redman, Genl. Mgr. — machinery, including lathe, drill press and shapers.

Wis., Antigo—Matlefs Bros. Co., G. Matlefs, Purch. Agt.—wood turning lathes, sanders and gluers.

Wis., Hartford—H. Lohr—presses, lathes, vises, etc. for automobile repair shop.

Wis., Milwaukee—The Smith Specialty Mfg. Co., 503 East Water St., H. Smith, Purch. Agt.—24 in. crank shaper, back geared.

Wis., North Milwaukee—J. Greenbaum Tanning Co.—vats.

Wis., Saukville—A. Horn—machinery for automobile repair work.

Wis., Tomahawk—The Tomahawk Steel and Mchy. Co.—punch and drill presses.

Minn., Minneapolis — The Sturr-Bullard Motor Co., 1208 Harmon Pl.—machine shop equipment.

Mo., Kansas City—The Bd. Educ., c/o J. B. Jackson, Secy.—manual training equipment for Woodland School.

Tex., Austin—The Pitts-Noyes Co., Inc., 112 East 5th St., H. Pitts, Pres.—equipment for foundry including small and medium punch presses, 16 in. shapers, filing machines, high speed drills, surface and universal grinders, ½ to 10 hp. lathes, 24 in. x 10 ft., 3 phase, 60 cycle, 220 volt. motors.

Que., Montreal—The Kennedy Taxi Co., Cathcart St., T. Kennedy, Purch Agt.—$2,800 worth of equipment for auto repair shop.

Mass., Boston—The United Shoe Mchy. Corp., 205 Lincoln St.—stripping machinery for 16 gage steel.

Md., Baltimore—The Chapman Self Locking Nut Co., 721 Equitable Bldg.—special milling machines for the manufacture of patented self-locking railroad nut.

Fla., Jacksonville—Certain Thyson Milk Co., Myrtle Ave.—ice machine, 30 ton capacity, motor driven, vertical inclosed type, with or without motor, with high side for 25 ton shell-type brine cooler.

Fla., Sarasota—The Sarasota Bee Co., C. M. Biorseth, Genl. Mgr.—complete machinery for the manufacture of bee hives, bee-keepers' supplies, window sash, door frames, blinds, etc. Prefer individual machines, motor power.

Ga., Ideal—The Ideal Bauxite Mining Co., W. Hite, Genl. Mgr.—crusher, grinder or pulverizer that will reduce bauxite so it will pass through 100 mesh screen, capacity 10 ton per hour. Not interested in crusher that will crush limestone or granite.

Ga., Madison—The 8th Dist. Agricultural & Mechanical School, B. F. Gay, Pres.—machinery for canning plant.

Ill., Chicago—The Alto Mfg. Co., 1801 Cornelia St.—one 36 in. square shear screw machine, ½ in.

Ind., Mitchell—W. T. Moore—machinery to grind crushed limestone to flour form.

Wis., Haugen—The Haugen Box & Crating Co., J. E. Lee, Purch. Agt.—modern mill-working machinery and machine tools including Duplex lathes, planers, sawing machines and presses.

Wis., Neillsville—The Sweet Shop—machinery for making candy.

Wis., Tomahawk—The Tomahawk Steel & Iron Wks., W. Drever, Pres.—drilling machines, 7-8 overhead traveling cranes, several ton presses, punches and complete set of light and heavy machines.

Ia., Oskaloosa—The Artificial Ice Co., R. F. Panders, Mgr.—machinery for artificial ice plant.

Ont., Toronto—The Automobile Service Syndicate, 21 Dundas St., E.—machinery for automobile repair shop.

Ont., Toronto—The Durant Motors Inc.—machinery for automobile manufacturing plant at Leaside.

Metal Working Shops

NEW ENGLAND STATES

Mass., East Boston (Boston P. O.)—B. M. Miller, 491 Saratoga St., has awarded the contract for the construction of a 1 story, 100 x 125 ft. garage, etc., on Saratoga St. Estimated cost, $50,000.

Mass., Northampton — F. C. Magrannis, Court St., is having plans prepared for the construction of a 1 story, 100 x 125 ft. garage and service station on King and North Sts. Private plans.

Mass., Springfield—W. J. Hyland Mfg. Co., 151 Dwight St., is receiving bids for the construction of a 3 story, 50 x 90 ft. plant on Liberty St., for the manufacture of heaters. Private plans.

Mass., Watertown — C. H. Hodge, 45 Bates Rd., will build a 1 story, 80 x 135 ft garage on Salem St. Private plans.

MIDDLE ATLANTIC STATES

Md., Baltimore—C. R. Bealmear, Title Bldg., represent interests who plan to build a 5 story garage and service station on Linden and Monument Sts. Architect not selected.

Md., Baltimore — The Cook Nuts Corp., Paca and Lexington Sts., has awarded the contract for the construction of a 4 story, 56 x 104 ft. factory on 1st and Toon Sts., to include a machine shop, etc. Estimated cost, $85,000. W. R. Spruill, Pres.

Pa., New Brighton—The Wyckoff Drawn Steel Co., Frick Bldg., Pittsburgh, will build a 1 story, 60 x 200 ft. factory at Wyckoff, near here. Estimated cost, $75,000.

Pa., Philadelphia—W. Price, c/o S. Tyre, Archt., 1509 Arch St., is having plans prepared for the construction of a 1 story sales and service station on 29th and York Sts. Estimated cost, $75,000.

The Weekly Price Guide

This Week's Market

Pittsburgh quotes soft steel bars at $1.65@$1.70, structural shapes at $1.70@$1.75 and plates at $1.60@$1.70 per 100 lb. Mill shipments, New York, of steel bars and bar shapes are quoted at $2.03, plates at $2.03@$2.08 and structural shapes at $2.03@$2.18 per 100 lb. Steel prices in the New York warehouses remain firm, with the exception of cold finished shafting and screw stock which are quoted at $4.03 as against $4.23 and cold-drawn flats, squares and hexagons, quoted at $4.53 as against $4.73. The new Pittsburgh basing card of Sept. 16 quotes increased discounts on black and galvanized wrought pipe.

Chicago reports increases in discounts ranging from 6 per cent to 7 per cent on wrought steel pipe. Advances of ½c. to 1c. per lb. are quoted on old metals. Chicago also reports a slight decline in babbitt metal prices.

Tin is quoted in New York at 27c. as against 27½c. per lb. Linseed oil has advanced 2c. in New York and 3c. per gal. in Chicago.

Cleveland prices have remained firm throughout the week.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	*$24.50
Northern Basic	†21.52
Southern Ohio No. 2	†22.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	†30.26
BIRMINGHAM	
No. 2 Foundry	*20.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	†21.76
Virginia No. 2	†28.74
Basic	†19.76
Grey Forge	†21.26
CHICAGO	
No. 2 Foundry local	†21.00
No. 2 Foundry, Southern, sil 2.25@2.75	†26.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	†22.96
Basic	†21.46
Bessemer	†21.96

*F. o. b. furnace. † Delivered.

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.25	3.28	3.10	3.38
No. 12	2.35	3.33	3.15	3.43
No. 14	2.45	3.38	3.20	3.48
No. 16	2.55	3.48	3.30	3.58
Black				
Nos. 17 and 21.	2.60	3.80	3.55	3.95
Nos. 22 and 24.	2.65	3.85	3.60	4.00
Nos. 25 and 26.	2.70	3.90	3.65	4.05
No. 28	2.75	4.00	3.75	4.15
Galvanized				
Nos. 10 and 11.	2.75	4.00	3.75	4.15
Nos. 12 and 14.	2.85	4.10	3.85	4.25
Nos. 17 and 21.	3.15	4.40	4.15	4.55
Nos. 22 and 24.	3.30	4.55	4.30	4.70
No. 26	3.45	4.70	4.55	4.85
No. 28	3.75	5.00	4.75	5.15

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of Sept. 16, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	68½	56	¾ to 1¼	39½	24½
LAP WELD					
2	61½	49	2	34½	20½
2½ to 6	65½	53	2½ to 4	37½	24½
7 to 8	62½	49	4½ to 6	37½	24½
9 to 12	61½	48	7 to 12	35½	22½
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	66½	55	1 to 1½	39½	25½
2 to 3	67½	56			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	59½	48	2	35½	22½
2½ to 4	63½	52	2½ to 4	38½	26½
4½ to 6	62½	51	4½ to 6	37½	25½
7 to 8	58½	45	7 to 8	30½	18½
9 to 12	52½	39	9 to 12	25½	13½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded.	60%	46%	52½%	43½%	68½%	56%
2½ to 6 in. steel lap welded.	51%	37%	55½%	40½%	65½%	53%

Malleable fittings. Classes B and C, Banded, from New York stock sell at plus 6%. Cast iron, standard sizes, 15% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (heavy)	5.00	6.50	8.25
Spring steel (light)	6.00	6.50	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.03
Hoop steel	3.88	3.29	3.48
Cold rolled strip steel	7.50	8.25	7.25
Floor plates	4.85	2.74	5.23
Cold finished shafting or screw	4.03	3.85	4.00
Cold finished flats, squares	4.53	4.35	4.50
Structural shapes (base)	2.88	2.74	2.88
Soft steel bars (base)	2.78	2.64	2.78
Soft steel bar shapes (base)	2.78	2.64	2.78
Soft steel bands (base)	3.43	.....	.....
Tank plates (base)	2.88	2.92½	2.88
Bar iron (mill 2.25)	2.78	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire	New York		3/32, 8½c. per lb.

¼—7.15c.; 5/32 to ¼—6.75c. Swedish iron sells at 18½c. per lb. in Chicago.

METALS

Current Prices in Cents Per Pound

	New York	Cleveland	Chicago
Copper, electrolytic (up to carlots), New York			12½@13
Tin, 5-ton lots, New York			27.00
Lead (up to carlots), St. Louis, 4.35; New York			4.75
Zinc (up to carlots), St. Louis, 4.60; New York			5.00
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.00	25@26	21.00
Antimony (Chinese), ton spot	5.25	6.00	6.00
Copper sheets, base	19.75	20.50	19.50
Copper wire (carlots)	15.50	15.50	14.00
Copper bars (ton lots)	18.00	22.00	17.50
Copper tubing (100-lb. lots)	19.50	23.00	19.50
Brass sheets (100-lb. lots)	15.25	18.00	15.25
Brass tubing (100-lb. lots)	18.00	20.00	18.00
Brass rods (1,000-lb. lots)	13.25	15.50	13.25
Zinc sheets (casks), (8% dis. carlots)	11.00	11.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	19.50	23.50	17.50
Babbitt metal (best grade)	70.00	36.50	32.00
Babbitt metal (commercial)	30.00	13.50	8.00

—Shop Materials and Supplies

MONEL METAL—Base price in cents per pound, f.o.b. Bayonne:

Shot	35.00	Hot rolled machine rods (base)	53.00
Blocks	35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold rolled rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

Special Nickel and Alloys

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	9.50	9.00	10.00
Copper, heavy, and wire	9.00	9.00	9.00
Copper, light, and bottoms	7.00	7.00	8.00
Lead, heavy	3.25	3.00	3.75
Lead, tea	2.00	2.00	2.75
Brass, heavy	5.00	5.00	7.50
Brass, light	4.00	3.00	4.50
No. 1 yellow brass turnings	4.50	4.00	5.00
Zinc	2.50	2.00	2.50

TIN PLATES—American Charcoal Plates—Bright

			New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:					
IC,	20x28,	112 sheets	21.50	.....	.....
IX,	20x28,	112 sheets	24.00	.....	.....
IXX,	20x28,	56 sheets	13.75	.....	.....
IXXX,	20x28,	56 sheets	15.50	.....	.....
IXXXX,	20x28,	56 sheets	17.00	.....	.....
"A" Charcoal Allaways Grade:					
IC,	20x28,	112 sheets	18.50	.....	.....
IX,	20x28,	112 sheets	21.50	.....	.....
IXX,	20x28,	56 sheets	12.25	.....	.....
IXXX,	20x28,	56 sheets	14.00	.....	.....
IXXXX,	20x28,	56 sheets	15.75	.....	.....

Coke Plates, Bright

Prime, 20x28 in.:				(56 sheets)
80-lb,	112 sheets	13.60	.....	.....
90-lb.,	112 sheets	13.80	.....	.....
100-lb.,	112 sheets	14.00	6.50	.....
IC,	112 sheets	14.30	6.65	.....
IX,	112 sheets	16.30	.....	.....
IXX,	56 sheets	9.15	.....	.....
IXXX,	56 sheets	10.15	.....	.....
IXXXX,	56 sheets	11.15	.....	.....

Terne Plate

Small lots, 8-lb. Coating:				
100-lb.,	14x20	$7.50	6.25	6.25
IC,	14x20	7.75	6.50	6.50
IX,	14x20	8.00	7.00	7.00

SHOP SUPPLIES

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	—60%	—60-5%
1⅛ and 1¼x3 in. up to 12 in.	—40%	60-10-10%	—55%
With cold punched sq. nuts	—30%	.....	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	—40%	.....	.. ..
Up to 1-in. diameter, with cold punched hex. nuts (plus std. extra of 10%)	—30%	.....	.....
Button head bolts, with hex. nuts	—20%	390 base	.....
Hex. head and hex. nut bolts	—20%	.....	.....
Lag screws, coach screws	—50-10%	.....	.....
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	50-10-10%	50-5%
Bolt ends, with hot pressed nuts	—50%	.....	.....
Tap bolts, hex. heads	—20%	.....	.....
Rivets, 7/16 in. dia. and smaller. *New list*	-50-10%	60-10-10%	-60-10%
Rivets, tinned	-50-10%	60-10-10%	—45%
Semi-finished nuts, all sizes	—70%	75%	50%
Case-hardened nuts	—60%	.....	.....
Washers, cast iron, ½ in., per 100 lb.	$5.00	$4.50 off	$4.50
Washers, cast iron, ⅝ in. and larger, per 100 lb	4.25	3.75 off	4.50
Washers, round plate, off list per 100 lb.	3.00	.....	.....
Nuts, hot pressed, sq. Off list	2.00	3.00	3.25
Nuts, hot pressed, hex. Off list	2.00	3.00	3.25
Nuts, cold punched, sq. Off list	1.50	3.00	3.00
Nuts, cold punched, hex. Off list	1.50	3.00	3.00
Rivets:			
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb	$4.40	3.50	3.68
Cone heads, ditto	4.50	3.60	3.78
1⅛ to 1¾-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	....
⅞ in. diameter *EXTRA*	0.15	.....	....
½ in. diameter *EXTRA*	0.50	.....	....
1 in. long, and shorter *EXTRA*	0.50	.....	....
Longer than 5 in *EXTRA*	0.25	.....	....
Less than 200 lb *EXTRA*	0.50	.....	....
Countersunk heads *EXTRA*	0.35	.....	....
Copper rivets	50-10%	40-10%	50%
Copper burs	25-10%	15%	20%

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb.	.055@.09	.09	.10
Wiping cloths per M., 13¼x13½	.....	55.00	55.00
Wiping cloths per M., 13¼x20½	.....	65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	2.75
Linseed oil, per gal., 5 bbl. lots	.80	.83	.87
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Fire clay, per 100 lb	(Ottawa, .80)	.80	
Coke, prompt furnace	$3.25	Connellsville	
Coke, prompt foundry	4.25@4.50	Connellsville	

Pa., Philadelphia—S. Wilensky, 826 Reed St., has awarded the contract for the construction of a 1 story, 60 x 208 ft. garage at 4028 Poplar St. Estimated cost, $50,000.

Pa., Schwenkville—The Bremer-Talis Co., has had plans prepared for the construction of a 2 story, 60 x 125 ft. sales and service station on Main and Perkimonen Sts. Estimated cost, $100,000. Schermerhorn & Phillips, 430 Walnut St., Philadelphia, Archts.

MIDDLE WEST STATES

Ill., Chicago — The Interstate Garage Corp., 110 North Market St., is having sketches made for the construction of a 10 story, 150 x 200 ft. garage on Wabash Ave. and South Water St. Estimated cost, $225,000. H. D. Jackson, Pres. L. E. Stanhope, 59 East Madison St., Archt.

Ill., Chicago—H. L. Newhouse, Archt., 4630 Prairie Ave., is receiving bids for the construction of a 1 story, 100 x 180 ft. garage at 5018-24 Cottage Grove Ave., for H. Salvat, 5322 Harper Ave. Estimated cost, $50,000.

Ill., Elmhurst—The Crefar Co., 144 York St., has awarded the contract for the construction of a 1 story, 50 x 135 ft. garage. Estimated cost, $55,000. Noted May 26.

Ill., Evanston—V. C. Carlson, 701 Church St., is having plans prepared for the construction of a 1 story, 40 x 130 ft. auto sales and repair shop. Estimated cost, $50,000. Architect not announced.

Ill., Herrin—The Illino's Central R.R., 135 East 11th St., Chicago, has awarded the contract for the construction of a 1 story, 60 x 200 ft. repair shop. Estimated cost, $60,000. Noted July 21.

Ill., Rock Island—J. M. Schaab, 1601 4th Ave., has awarded the contract for the construction of a 1 story, 62 x 150 ft. garage. Estimated cost, $50,000. Noted Sept. 15.

O., Columbus—The Columbus Forge & Iron Co., West 1st Ave., has awarded the contract for the construction of a 1 story, 70 x 200 ft. and 110 x 120 ft. plant. Estimated cost, $50,000. Noted Aug. 11.

Wis., Beloit—The Beloit Iron Wks. manufacturer of paper mill machinery, plans to build a 1 story, 60 x 85 ft. pattern shop and machine shop. Estimated cost, $50,000. Address E. H. Neese, Vice-Pres. Architect not seletced.

Wis., Hartford—H. Lohr is receiving bids for the construction of a 1 story, 50 x 142 ft. garage, etc. on North Main St. Estimated cost, $55,000. Private plans.

Wis., Madison—The University of Wisconsin, M. McCaffrey, Secy., will receive bids until Sept. 26 for the construction of a 1 story addition to its service building and electric sub-station. Estimated cost, $55,000. A. Peabody, Capitol, State Archt.

Wis., Manitowoc—The city, c/o F. L. Alter, City Hall, is having revised plans prepared and will receive bids in October for the construction of a 4 story, 210 x 360 ft. high school. Plans include a machine shop. Estimated cost, $1,400,000. Perkins, Fellows & Hamilton, 814 Tower Ct., Chicago, Archts.

WEST OF THE MISSISSIPPI

Colo., Denver—The General Iron Wks. Co., 1720 California St., will probably receive bids in December for the construction of an iron foundry on 33d and Blake Sts. Estimated cost, $500,000. J. R. Henderson, 1720 California St., Engr.

Colo., Denver—The Super-Service Motor Assn., Colorado Bldg., plans to build a 3 story, 125 x 250 ft. co-operative motor repair shop on Sheer Blvd., Bannock St. and West 7th Ave. Estimated cost, $300,000. H. W. J. Edbrooke, Tabor Opera House Bldg., Archt.

Ia., Des Moines—J. P. Condon and G. E. Davis, 3200 Ingersoll Ave., have awarded the contract for the construction of a 2 story, 135 x 167 ft. garage. Estimated cost, $60,000.

Minn., Minneapolis — The Sturr-Bullard Motor Co., 1208 Harmon Pl., has awarded the contract for the construction of a 2 story, 75 x 120 ft. or 75 x 200 ft. garage on La Salle Ave. and 13th St. Estimated cost between $45,000 and $65,000.

Mo., Eldon—The Chicago, Rock Island & Pacific R.R., 137 West Van Buren St., Chicago, Ill., has awarded the contract for the construction of a 1 story round house, here. Estimated cost, $50,000.

Mo., Trenton—The Chicago, Rock Island & Pacific R.R., 137 West Van Buren St., Chicago, Ill., will build a 1 story, 87 x 400 ft car repair shop. Estimated cost, $60,000. Noted June 2.

CANADA

Ont., Leaside—The Durant Motors Inc., Toronto, plans to build a 3 story, 130 x 600 ft. factory, here, for the manufacture of automobiles. Estimated cost, $800,000.

Ont., Toronto—The Automobile Service Syndicate, 21 Dundas St., E., is having plans prepared for the construction of a 3 story garage on Dundas St. Estimated cost, $50,000. N. A. Armstrong Co., Ltd., 7 King St., E., Archts.

General Manufacturing

NEW ENGLAND STATES

Me., Farmington — The Franklin Farm Products Co. has awarded the contract for the construction of a 1 story, 30 x 100 ft. canning factory.

Mass., Fall River—The Amer. Printing Co., 56 Water St., (textile fabrics), has awarded the contract for altering and building additions to plant. Estimated cost, $40,000.

Mass., Roxbury (Boston P. O.)—J. Donnelley & Sons, 97 Warrenton St., have awarded the contract for the construction of a 2 story, 60 x 125 ft. plant on School St., for the manufacture of poster advertisement.

R. I., Providence — The Sunshine Ice Cream Co., 372 Cranston St., will build a 2 story, 40 x 80 ft. ice cream plant on Cranston St. Noted June 9.

R. I., Providence—C. S. Tanner Co., 246-256 South Water St., is having plans prepared for the construction of a 2 story, 56 x 60 ft. starch factory and storage building. Estimated cost, $40,000. W. R. Walker & Son, 49 Weybosset St., Archts.

MIDDLE ATLANTIC STATES

N. Y., Amsterdam—The Mohawk Carpet Mills, Inc., 57 Lyons St., have awarded the contract for the construction of a 6 story, 56 x 60 ft. addition. Estimated cost, $275,000. Noted July 21.

Pa., Braddock—B. Markvitz Baking Co., 1019 Talbot Ave., is receiving bids for the construction of a 3 story, 70 x 75 ft. bakery. Estimated cost, $75,000. W. M. Williams, Magee Bldg., Pittsburgh, Archt.

Pa., Hollidaysburg—The Blair Ice and Storage Co., 1112 Allegheny Ave., recently organized with $100,000 capital stock, plans to build a 4 story cold storage plant. G. B. Miller, Pres. Estimated cost, $100,000.

Pa., Monessen—The Reliable Upholstering Co. is receiving bids for the construction of a 3 story, 23 x 100 ft. factory. Estimated cost, $25,000. J. M. Beal & Son, Monessen, Archts.

Pa., Philadelphia—M. Polin, 5th and Pine Sts., will soon award the contract for the construction of a 1 and 2 story, 12 x 22 ft. and 22 x 80 ft. factory at 1520 North Broad St., for the manufacture of woolen goods. L. B. Rothchild, 1210 Sansom St., Archt.

Pa., Pittsburgh—The Air Reduction Co., 342 Madison Ave., New York, is having sketches made for the construction of a 2 story oxygen plant on Ridge Ave., here. Estimated cost, $250,000. Francisco & Jacobus, 511 5th Ave., New York, Archts. and Engrs.

Pa., Sunbury—The Butter Krust Baking Co., c/o B. Apple, has awarded the contract for the construction of a 2 story, 70 x 130 ft. bakery at 249 Eckman Ave. Estimated cost, $150,000. Noted Aug. 18.

Pa., Williamsport—C. A. Reed & Co., Laurel and Willow Sts., will soon award the contract for the construction of a 4 story, 70 x 180 ft. factory on Chestnut St., for the manufacture of paper goods and novelties. Estimated cost, $100,000. Noted July 28.

MIDDLE WEST STATES

Ill., Chicago—W. G. Kohlfeldt, Archt., 400 North Michigan Ave., is receiving bids for the construction of a 1 story, 76 x 133 ft. noodle factory on State and 46th Sts., for the Klein Noodle Co., 3713 Wentworth St. Estimated cost, $25,000.

Ill., Chicago—The Mothers Wet Wash Co., 6337 North Clark St., is having plans prepared for the construction of a 1 story, 60 x 125 ft. laundry on Lawrence Ave., near Irving Ave. Estimated cost, $40,000. C. E. Pearson, 1930 North Keystone Ave., Archt.

Ill., Moline—The Moline Daily Dispatch, 1509 3rd. Ave., is having plans prepared for the construction of a 2 story publishing plant. Estimated cost, $150,000. Clausen & Kruse, Central Office Bldg., Davenport, Ia., archts.

Ill., Mt. Vernon—The Faulkner Candy Co., c/o W. H. Faulkner, plans to build a 3 story factory. Estimated cost, $50,000. Architect not selected.

O., Cleveland—The R. B. Biscuit Co., 2522 Carroll Ave., has awarded the contract for the construction of a 1 story, 32 x 107 ft. addition to its factory. Estimated cost, $25,000.

Wis., Clinton Junction — The Bowman Dairy Co., 140 West Ontario St., is having plans prepared for the construction of a 1 story, 57 x 200 ft. bottling plant. Estimated cost, $60,000. F. B. Gray, First Natl. Bank Bldg., St. Louis, Mo., Archt.

Wis., Jefferson—C. A. Baumann is having plans prepared for the construction of a 2 story, 60 x 95 ft. factory for the manufacture of cheese. Estimated cost, $40,000. Private plans.

Wis., Milwaukee—The Red Star Yeast and Products Co., 79 Buffalo St., has awarded the contract for the construction of a 50 x 100 ft. addition to its vinegar plant on 27th St. and St. Paul Ave. Estimated cost, $15,000. Noted Aug. 25.

Wis., Portage—The Portage Co-operative Canning Co., c/o W. H. Hallwell, Pres., Michel Bldg., has purchased a site and plans to build a 3 story, 60 x 210 ft. canning plant. Estimated cost, $275,000. Architect not selected.

Wis., Sauk City—The Sauk City Canning Co. plans to construct a cannery, to include a 3 story, 80 x 80 ft. main building, a 1 story, 32 x 40 ft. boiler house and a 2 story, 75 x 120 ft. warehouse. Estimated cost between $75,000 and $80,000. J. Dresen, Sauk City, Archt. Noted Sept. 8.

Wis., Waukesha—The Manitowoc Church Furniture Co., has had plans prepared for the construction of a 1 story, 60 x 150 ft. factory on Main St. Estimated cost, $60,000. C. F. Schuetze, Mgr. Private plans.

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Ia., Davenport—The Davenport Ice Co., 1st and Myrtle Sts., plans to build a 2 story plant for the manufacture of ice. Estimated cost, $75,000. Architect not selected.

Ia., Davenport — Kambach & Kettman Leather Co. plans to build a 2 story, 37 x 80 ft. factory. Estimated cost, $50,000. Architect not selected.

Ia., Oskaloosa—R. F. Panders, Mgr. of the Artificial Ice Co., has awarded the contract for the construction of a 2 story cold storage plant. Estimated cost, $55,000.

Kan., Hutchinson—The Hutchinson Office Supply Printing co. c/o G. Hanson, has awarded the contract for the construction of a 2 story, 60 x 80 ft. printing plant. Estimated cost, $60,000.

Mo., Kansas City—The Kelly Mill Co., c/o A. B. Kelly, Pres., Rochester and Park Sts., is having plans prepared for the construction of a flour mill. Estimated cost, $500,000. Architect not announced.

Mo., Sedalia—Swift & Co., c/o G. H. Trader, local Mgr., will soon award the contract for the construction of a 2 story, 100 x 200 ft. packing plant. Estimated cost, $175,000. Architect not announced.

Okla., Oklahoma City—The Smith Baking Co., 437 West Park St., plans to build a 2 story bakery on 39th and Oklahoma Aves. Estimated cost, $150,000. Architect not selected.

Tex., Amarillo—The Chicago, Rock Island & Pacific R.R., 139 Van Buren St., Chicago, Ill., has awarded the contract for the construction of a 92 ft. round house, containing 8 stalls. Estimated cost, $50,000.